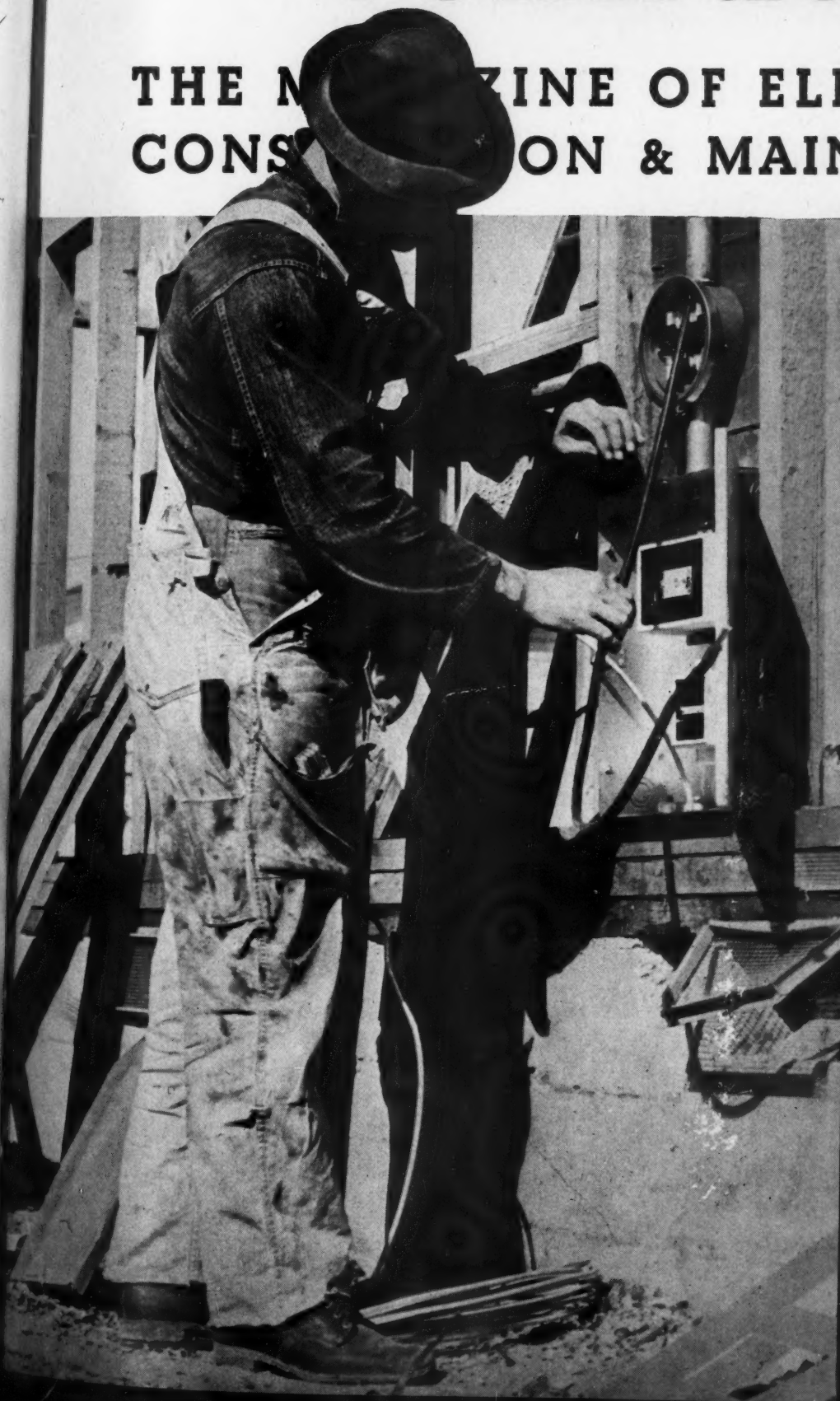


Electrical Contracting

THE MAGAZINE OF ELECTRICAL
CONSTRUCTION & MAINTENANCE



IN THIS ISSUE . . .

wiring practices in the
petroleum industry . . .
color as a factor in illumi-
nation . . . rewind cost
analysis . . . methods for
reconnecting motors . . .
selecting controls . . . and
practical ideas for the
shop and job.

JUNE • 1946



Yankee Stadium is now the most brilliantly lighted ball park in America. More than 1200 new Type L-69 floodlights provide a uniform 200 foot-candle level over the entire $3\frac{1}{4}$ -acre playing area. This spectacular illumination not only helps the highly skilled players to give their top performance, but enables every one of the 87,000 spectators to see every play clearly. It is the result of 20 years of experience that G-E engineers have accumulated while designing successful floodlighting for night sports and recreation.

New G-E Floodlights
 ★ CUT INSTALLATION TIME ★ SIMPLIFY MAINTENANCE ★ INCREASE EFFICIENCY
for large or small installations

Save time in installing and replacing lamps—lamp is inserted from above the reflector where it can easily be reached without disturbing the reflector position.

Save time in assembly—no separate front door to handle.

End losses and hazards from broken front glass—Type L-69's front door glass is impact resisting.

Save time in adjustment—degree scales and rifle sights provide for easy aiming either by chart or by visual sighting, as preferred.

Less cleaning required—spun-sealed front door and thoroughly gasketed socket housing provide permanent

seal against dirt and bugs. Ends lamp failures from driving rain and insects.

Easier to clean—normal access is through lamp opening—reflector need not be moved ordinarily, but can be tilted easily if desired, without tools. Repositioning stop included.

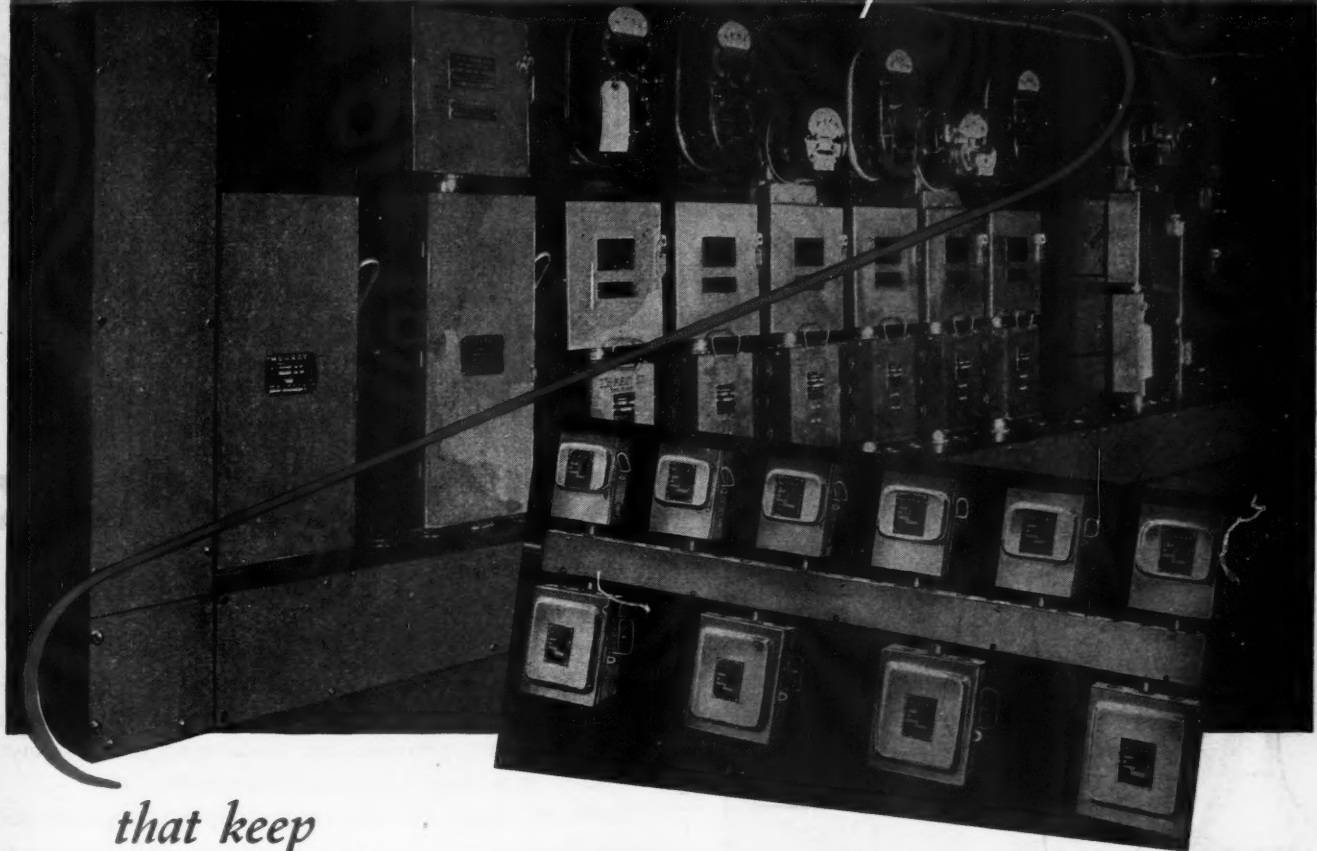
More light in the beam—new reflector design provides increased efficiency; new construction features help retain initial efficiency longer.

Study these features. They're really good news! They will help you make your proposition more attractive. For other important details, write for booklet GEA-4590, Apparatus Department, General Electric Company, Schenectady 5, N. Y.

GENERAL  ELECTRIC

451-04-3200

Wiring TROUGHS by Murray



that keep
the
TOUGHEST
"GANGS"
in line

No matter how complicated, how long or how many turns (ever-ready elbows do the trick), Murray Wiring Troughs are easy and quick to install. They are strong and rigid when in place, yet easy to get into, through instantly removable covers. Tap for a branch anywhere—always a knockout handy. Four lengths—and four depth-width combinations. The installations above are typical—and the first you put in will look just as shipshape and prove the easiest job you can remember. Metropolitan Device Corporation, Brooklyn, N. Y.



Murray

WIRING TROUGHS for "ganging"

Metropolitan Device Corp.
Brooklyn, N. Y.

Please send catalog of
Murray Wiring Troughs.

Name

Company

Address

ELECTRICAL CONTRACTING. Published monthly, price 35 cents a copy. Vol. 45, No. 6. Allow at least ten days for change of address. RETURN POSTAGE GUARANTEED. Publication Office, 99-129 N. Broadway, Albany 1, N. Y. All communications about subscriptions should be addressed to J. E. Blackburn, Jr., Vice President (for Circulation Operations), Electrical Contracting, 330 West 42nd St., New York 18, N. Y. Subscription Rates—U. S. and possessions, \$3.00 a year, \$4.00 for two years, \$5.00 for three years. Canada \$4.00 a year, \$6.00 for two years, \$8.00 for three years. Pan American countries \$6.00 for one year, \$10 for two years, \$12.00 for three years. All other countries \$15.00 a year, \$30.00 for three years. Please indicate position and company connection on all subscription orders. Entered as second-class matter August 29, 1936, at Post Office, Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. Copyright 1946 by McGraw-Hill Publishing Company. Cable address: "McGraw-Hill; New York." Member A. B. P. Member A. B. C.

Here Arcs Can't Start Fires or Cause Explosions...

All Appleton Explosion-Proof Equipment is approved by Underwriters' Laboratories.

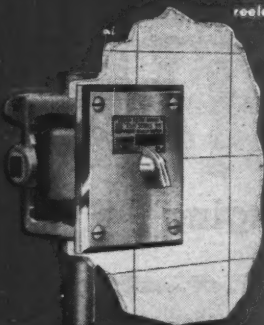


Type FSQX Explosion-Proof and Dust-Tight Dead-End Receptacle with interlocking safety switch and Type FP Plug.

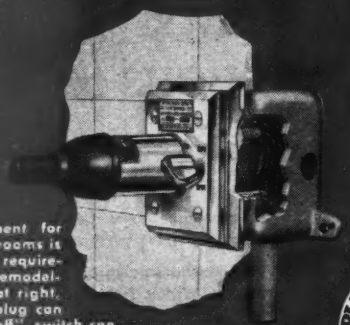
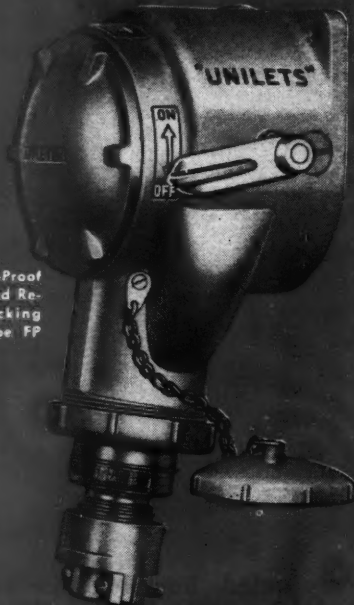


Type EVA Pendant Type Explosion-Proof Lighting Fixture—Also made in Ceiling and Bracket Types.

Explosion-Proof, Dust-Tight Appleton "Reelite" keeps electric cable reeled up out of the way. Spring-driven.



Appleton Explosion-Proof Equipment for hospital surgeries and anaesthesia rooms is completely sealed and meets every requirement, both for new construction and remodeling. Receptacles, like that shown at right, have interlocking safety switches; plug can not be withdrawn until current is "off", switch can not be turned "on" until plug is securely seated.



THEY'RE CONFINED BY APPLETON EXPLOSION-PROOF EQUIPMENT

Tough, MALLEABLE IRON Explosion-Proof Conduit Fittings and Lighting Fixtures, expertly designed by Appleton electrical engineers, provide the wide margin of safety vitally necessary in wiring hazardous locations.

Chemical plants, oil refineries, hospital surgeries, locations where flammable lacquers are applied—all locations where explosive or flammable vapors, dusts or gases are present—need this protection for the safety of property and personnel.

Like all Appleton "Unilets," the strong, unbreakable bodies of Appleton Explosion-Proof Fittings are smoothly cast, roomy, truly threaded and machined, easy to install. There is an Appleton fitting exactly suited to every explosion-proof requirement.

For every wiring job—explosion-proof or otherwise—save time, build better—specify fittings from the COMPLETE Appleton line of over 15,000 items—described and illustrated in the big Appleton Catalog. Gladly sent on request to any user of electrical fittings.



Sold Through Wholesalers

APPLETON ELECTRIC COMPANY
1704 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS

Branch Offices: NEW YORK, 76 Ninth Avenue • DETROIT, 7310 Woodward Avenue • CLEVELAND, 1836 Euclid Avenue • SAN FRANCISCO, 655 Minna Street • ST. LOUIS, 420 Frisco Bldg. • LOS ANGELES, 100 North Santa Fe Avenue • ATLANTA, 175 Luckie Street, N. W. • BIRMINGHAM, 6 N. Twenty-first Street • MINNEAPOLIS, 305 Fifth Street, S. • PITTSBURGH, 414 Rossman Bldg. • BALTIMORE, 100 East Pleasant Street • BOSTON, 10 High Street • DENVER, 1530 Sixteenth Street • PHILADELPHIA, 1017 Cherry Street

Resident Representatives: Cincinnati, Dallas, Kansas City, Milwaukee, New Haven, New Orleans, Seattle

A P P L E T O N

CONDUIT FITTINGS • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES

Electrical Contracting

Which is consolidated The Electrician and Electrical Record Established 1921

W. T. Stuart..... Editor
Alice McMullen..... Associate Editor
Berlon C. Cooper..... Eastern Editor
August Eckel..... Middle West Editor
W. A. Cyr..... Pacific Coast Editor
H. W. Young..... Southwest Editor
Hugh P. Scott..... Assistant Editor
Harry Phillips..... Art Editor
Dexter Keezer..... Director, Economic Staff
Donald D. Hogate
Manager, Washington Bureau

M. S. MacNaught.. Manager
W. W. Garey..... Assistant Manager

DISTRICT MANAGERS

A. B. Conklin, Jr..... New York
S. A. Jones..... New York
F. J. Seiler..... Cleveland
W. B. Heaps..... Chicago

Lee H. Hill..... Publisher

McGRAW-HILL PUBLISHING COMPANY, INC.
JAMES H. McGRAW, Founder and Honorary Chairman; JAMES H. McGRAW, Jr., President; CURTIS W. McGRAW, Senior Vice-President and Treasurer; JOSEPH A. GERARDI, Secretary; NELSON BOND, Director of Advertising; EUGENE DUFFIELD, Editorial Assistant to the President; J. E. BLACKBURN, Jr., Director of Circulation. Publication Office, 99-129 North Broadway, Albany, N. Y. Editorial and Executive Offices, 330 W. 42nd St., New York 18, N. Y. Branch Offices: 520 North Michigan Ave., Chicago 11; 68 Post St., San Francisco 4; Aldwych House, Aldwych, London, W.C. 2; Washington; Philadelphia 2; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; Atlanta 3; Los Angeles 13; Pittsburgh 22. Member A.B.C. Member A.B.P.

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management in the field of electrical construction and maintenance.

Contents for June, 1946

At a glance.....	55
For Want of Wiring.....	57
Wiring for the Petroleum Industry....	59
By G. A. HAUSKE—Tested methods used to combat electrical system installation and maintenance problems.	
Contractors at Lighting Show.....	64
Contractors and exhibits at the International Lighting Exposition reviewed in pictures.	
Color in Lighting.....	66
By CHARLES L. AMICK—The definition of color, its use in lighting, and other practical aspects of its measurement specification or application.	
What Is the Markup?—Part III.....	70
By RAY ASHLEY—A discussion of research and time studies, and adjustment factor.	
Winding and Connecting Time.....	73
By GEORGE P. SVENDSEN—Other factors than horsepower and speed provide more accurate measures for estimating time and checking production.	
Rewinding and Reconnecting A-C Motors—Part II.....	76
By R. G. CAZANJIAN—The second article on the discussion of the theory of rewinding and reconnecting induction motors.	
Industrial Electrification.....	97
How to Select Controls—III	
Departments	
Practical Methods.....	79
Equipment News.....	85
Data Sheet.....	102
Reader's Quiz.....	106
Motor Shops.....	115
Modern Lighting.....	125
Electronics.....	143
Questions on the Code.....	153
In the News.....	163
Manufacturers News.....	175
Advertisers Index.....	188

Get these **4** Major Advantages

with **CERTIFIED STARTERS**

LONGER FLUORESCENT LAMP LIFE
BETTER LAMP PERFORMANCE,
FEWER REPLACEMENTS
LESS MAINTENANCE

and here's why

- 1** Certified Starters are made to exacting specifications set up by foremost lighting experts to assure dependable operation and service.
- 2** Certified Starters are tested, checked and **CERTIFIED** as to compliance with these specifications by impartial experts, Electrical Testing Laboratories, Inc.



Here's how to identify a Certified Starter.
Look for the mark. It's stamped on each starter.

And Certified Starters are regularly rechecked at factories—under actual operating conditions—to assure you of continued high quality manufacture. Give your customers longer lamp life—better lighting service from fixtures—with **CERTIFIED STARTERS**.

Certified Starters are specified equipment of FLEUR-O-LIER and RLM fluorescent lighting fixtures.

-----The Manufacturers of-----

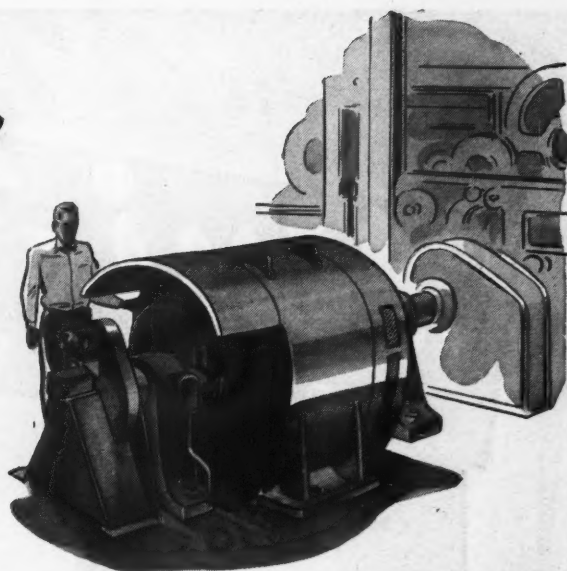
Certified Starters

The Arrow-Hart and Hegeman Co., Hartford, Connecticut
The Bryant Electric Co., Bridgeport, Connecticut
Dura Electric Lamp Co., Newark, N. J.
General Electric Co., Bridgeport, Connecticut
Harvey Hubbell, Inc., Bridgeport, Connecticut

Instant Glow Starter Corporation, New York, N. Y.
Kuthe Laboratories, Inc., Newark 4, N. J.
The Lloyd Products Co., Providence, R. I.
Pass & Seymour Co., Syracuse, N. Y.
Sheldon Electric Co., Irvington, N. J.

"What! STOP A 30" CALENDER ROLL IN LESS THAN 14" OF ROLL TRAVEL!"

"Right! And besides that emergency stop, give us 10 to 1 speed range on the motor and hold speed close. The torque characteristic of our calender requires that the motor have high overload capacity at low speeds without overheating. And because of operating conditions, we want sparkless commutation too!"



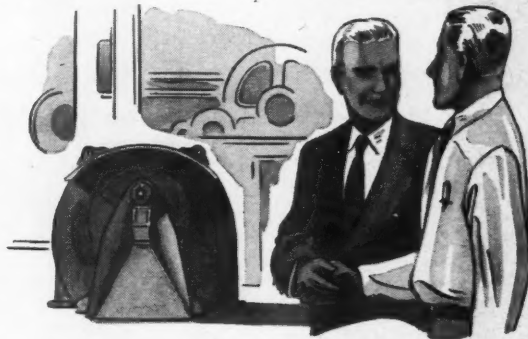
B-b-u-t... "No buts" said Mr. Rubber Mill Man, "that's exactly what we need. You see, we're experimenting with new materials on our rolls, and since we can't pre-determine best roll speeds for them, we must have a drive that'll give us complete range of speeds, and at the same time, complete protection for our workers".



"**In A Nutshell**, you and the control engineers must design a calender drive system that'll give us higher and lower calender speeds, closer speed regulation and sudden emergency stopping — "all three!" Well, we set up meetings between the control and motor designers to plan a coordinated design that would meet the needs.



An Automatic Speed Control incorporating both our m-g set and "Regulex" exciter was designed to hold selected speed within close limits. And, after a careful analysis of required load characteristics, we designed a 400 hp d-c motor of low inertia for quick stopping . . . and which also provided speed range from 25 to 250 rpm.



Remember That 14" Stop? After the system went in, we stopped the rolls first at 18" . . . easy. Then at 14" . . . at 12" . . . at 9"! And we probably would have stopped 'em even shorter but for possible danger of too sudden stops to the calender gear system. And commutation? After 6 months, the operators say it's perfect. A 2048



Moral: Every time Allis-Chalmers discovers new ways of solving special motor problems, like this one, it also learns how to build better standard motors for you! Watch for these new and better motors from A-C. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

Wait 'til you see the NEW

ALLIS-CHALMERS MOTORS!

Uni-Formid

* PACKAGED SWITCHBOARD LINE

**72-HOUR
DELIVERY**

MOTOR
CONTROL

CIRCUIT
BREAKER
TYPE A

CIRCUIT
BREAKER
CONVERTIBLE

SWITCH & FUSE
CONVERTIBLE

SERVICE
CENTERS

Linsco
ELECTRICAL PRODUCTS
LOS ANGELES

*REGISTERED TRADE MARK

GENERAL ELECTRIC Announces...

NEW

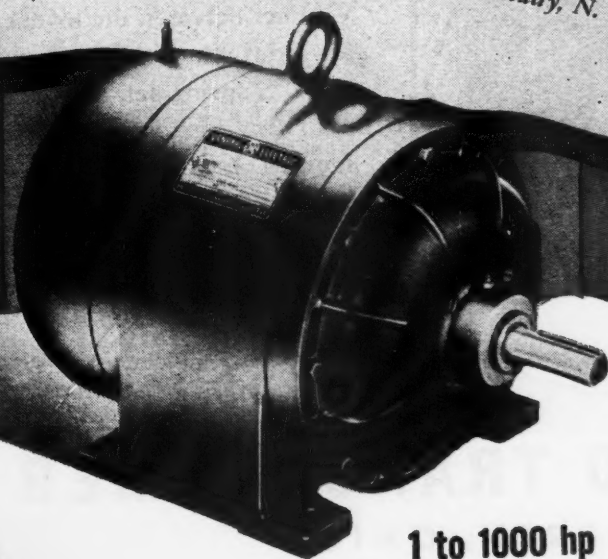
Totally Enclosed

TRI-CLAD MOTORS

In 1940, G.E. introduced the Tri-Clad open motor—with emphasis on the feature that industry wanted most in a motor, *protection*. Since then, more Tri-Clads have gone into service than any other integral-horsepower motor.

Today, we are ready with a new line of Tri-Clad motors—*totally enclosed, fan-cooled motors*—built on Tri-Clad design principles in both standard and explosion-proof types.

We believe that these are industry's most dependable motors. They are designed specifically for use in many adverse atmospheres—in iron dust, outdoors, in hazardous areas, and chemical atmospheres. Their scope of application is as wide as the field of industrial motor use. Safeguarded against most sources of motor damage, their longer life and lower maintenance will make them economical motors for use on almost every job. General Electric Company, Schenectady, N. Y.



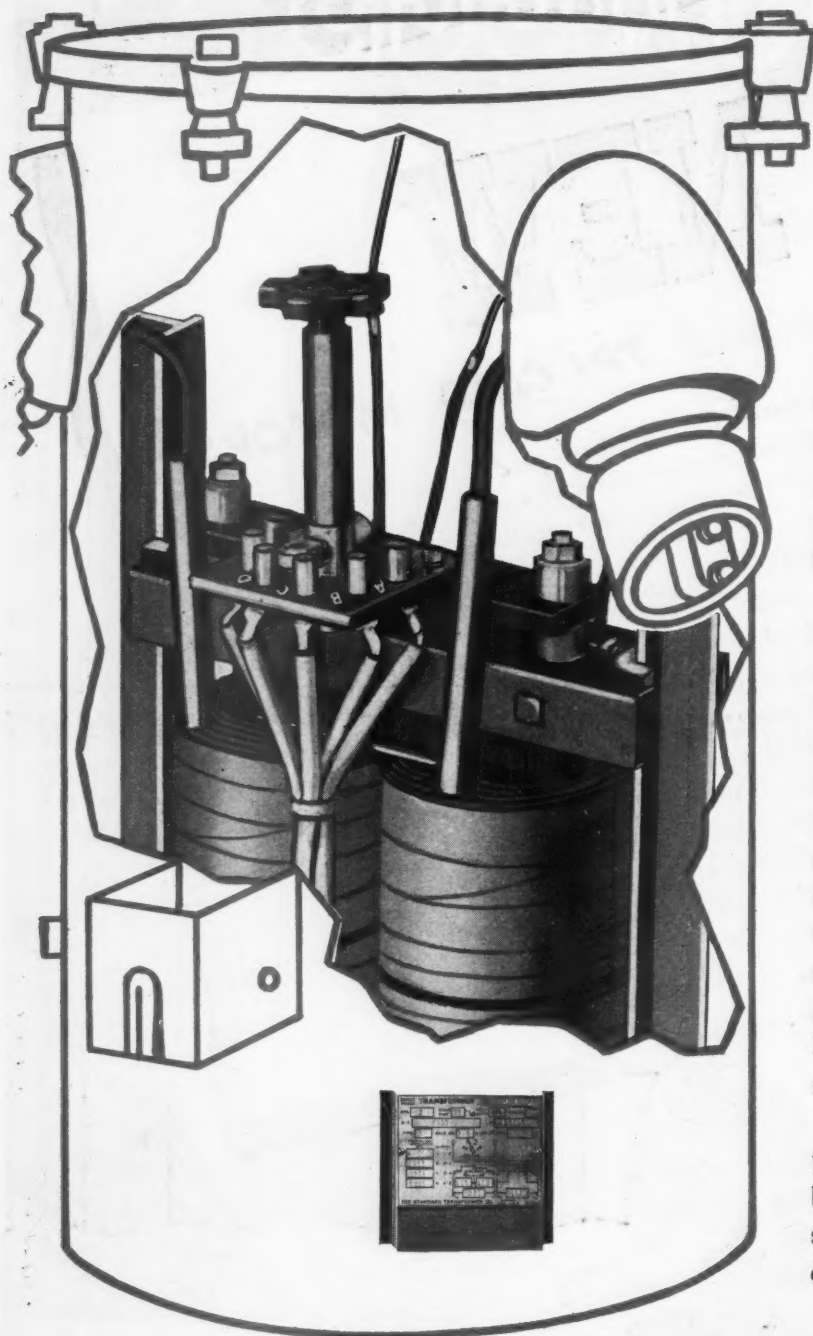
1 to 1000 hp

COMPLETE ENCLOSURE
FOR PROTECTION
AGAINST DIRT,
DUST, AND WEATHER

Standard

TRADE MARK

TRANSFORMERS WITH **NEW** RATIO ADJUSTER



Simplified adjustment for the service men and installers... making their work quicker, easier, and more dependable... that is the trend which leads to better customer service and greater economies. **STANDARD'S new ratio adjuster fits into these requirements.**

STANDARD distribution transformers have proved very satisfactory, hence there are no changes in the core, coil, tank, etc. The new ratio adjuster replaces the link type connection block. Now, no tools are needed to change ratio. The handle operates above oil level. With reference to diagram name plate on the side of the transformer, positive setting is assured. Contact between the bridged and stationary contacts is positive with **STANDARD'S** spring set, snap action assembly. Working parts of the adjuster are immersed in oil.

Whether your choice runs to conventional designs, or types with built-in or built-on accessories, **STANDARD** can supply you. **Data of engineering type is available to you... write today.**

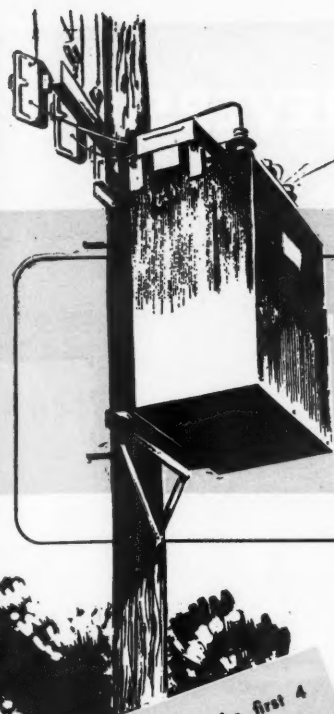
THE STANDARD TRANSFORMER CO.

WARREN, OHIO

Offices in Principal Cities

*for every class
of service.*

MAKERS OF POWER, DISTRIBUTION, INSTRUMENT, STREET LIGHTING
AND TESTING TRANSFORMERS... OIL, ASKAREL OR AIR COOLED



LET G-E PYRANOL CAPACITORS Boost Your Electrification Gains

*Assure Top Performance, Reduced
Power Costs, Through High Power Factor*

"Saved \$2,000 in the first 4 months!" reports one mine operator after he had installed G-E pole-type Pyranol capacitors at a cost of \$5,000.

The economies obtained by increased electrification of industry can be seriously affected by a low power factor and the resulting high power costs. This needn't happen in your case—if you take advantage of the savings made possible by proper capacitor utilization. If you buy power and your contract contains a power-factor adjustment or kva-demand clause, capacitors can reduce your power costs by giving you more "working" power for every dollar you spend.

If you operate your own power plant, capacitors enable your generators to deliver more "payload" kilowatts—up to their maximum rating. In either case, they improve your voltage, reduce power losses, and help prevent system overloading. Very often, too, a capacitor installation permits the addition of more motors or other electrical equipment to a "fully loaded" system without the expense of additional feeders, transformers, or generators.

Users tell us that G-E capacitors return from 57 per cent to 120 per cent of their original cost every year. In other words, they pay for themselves many times over. Reliability of operation, of course, is essential before you can realize any worthwhile savings and G-E Pyranol capacitors are noted for the care and precision used in their manufacture. They're non-inflammable, hence less expensive to install. They are smaller than other types, require less space, and they have stable operating characteristics that assure long life.

Applying capacitors to secure maximum savings requires a study of your existing and anticipated circuits and power demands. General Electric engineers, because of their wide experience in this field, are able to render this service. Why not consult with the G-E office nearest you? Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

GENERAL  ELECTRIC
407-107-8700



ENCLOSED CAPACITOR UNITS
for single motors or small loads. Ratings from 0.5 to 7.5 kvar, 230 volts; 1 to 15 kvar, 460 and 575 volts for 1-, 2-, or 3-phase.



SMALL INDOOR EQUIPMENTS
occupy little space. Available in 1-, 2-, or 3-phase ratings up to 90 kvar at 230 volts; 180 kvar at 460, 575, 2400, 4160, 4800 and 7200 volts.



LARGE INDOOR EQUIPMENTS
—Large capacity in a single block. Ratings up to 630 kvar, 230 volts; 1260 kvar, 460 and 575 volts; and 2520 kvar, 2400 to 13,800 volts. With or without breakers.



POLE-TYPE OUTDOOR EQUIPMENTS—Completely weatherproof, all-welded steel housing. Pole or base mounting. For primary circuits, 2400, 4160, 4800, and 7200 volts; Ratings up to 180 kvar, 1-, 2-, or 3-phase.



LARGE OUTDOOR EQUIPMENTS
—Large capacity in a single block. Weatherproof. With or without circuit breakers. Available in same voltage, kvar, and phase ratings as large indoor equipments.

"3C" BULLETIN 5360 NON-REVERSING STARTERS give reliable DC MOTOR PROTECTION

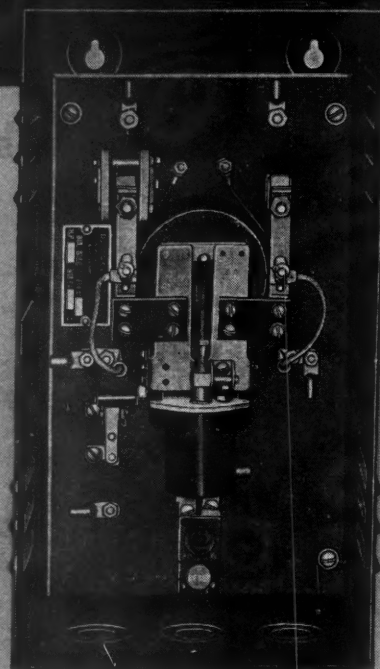
For application to constant speed DC Shunt or Compound Wound DC Motors, or adjustable speed motors under 2 to 1 speed range, where jogging is not required and where starting periods are not more than 5 seconds out of each 80 seconds, this magnetic starter provides the following features:

1. Time limit acceleration.
2. Ventwound resistor for effective heat dissipation.
3. Thermal Overload Relay—manual reset.
4. Single Coil operation.
5. Blowout and Arc shield on Line Contactor.
6. Renewable Forged Copper Contact Tips.
7. Arranged for 2 or 3 Wire Pilot devices.
8. Enclosed, Wall Mounted.

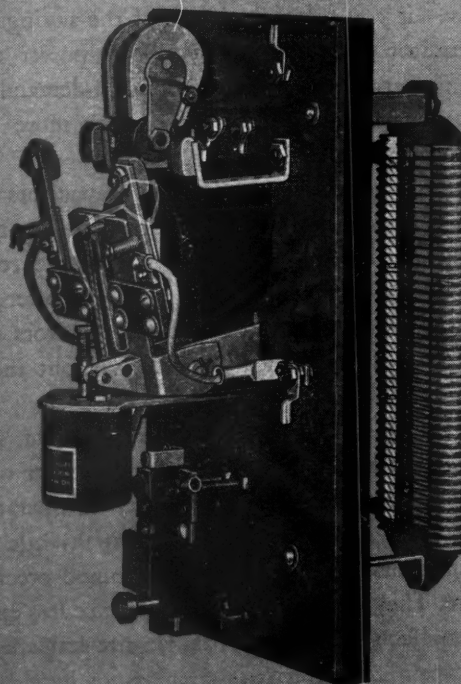
When the "Start" button is momentarily depressed, the operating coil is energized and main line contacts close immediately. Closing of the accelerating contacts is delayed on adjustable pre-determined time interval by a vacuum air dashpot. When accelerating contacts close, starting resistor is by-passed, putting the motor across-the-line.

When the "Stop" button is depressed, gravity and spring action of contacts force both main line and accelerating contacts open quickly—without retarding effect from the dashpot.

*Write for descriptive Bulletin 5360.
The "3C" line is the ideal line
for Distributors to handle*



OPEN VIEW



SIDE VIEW OF STARTER



THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL



PLANT WIRING AND RE-WIRING SIMPLIFIED

G-E No. 1799 VARNISHED-CAMBRIC INTERLOCKED-ARMOR CABLE MEANS

**Quicker wiring today
Easier circuit changes tomorrow**

Plants which met wartime deadlines for wiring time by the use of G-E interlocked-armor cable are among the big boosters for its peacetime use. It permits faster installation of power distribution systems—both primary and secondary circuits. Future relocation problems are simplified, too, because existing cable and fittings are easily adapted to new circuits.

General Electric's No. 1799 varnished-cambric interlocked-armor cable—adopted to meet the urgent demands of speedy wartime installation—provides many time- and money-saving features for plant wiring. Actual installation time for power circuits can be cut as much as 50 per cent with this flexible cable for two reasons: (1) steel conduits and pull boxes are not necessary, and (2) comparatively little time is needed for layout of circuits because

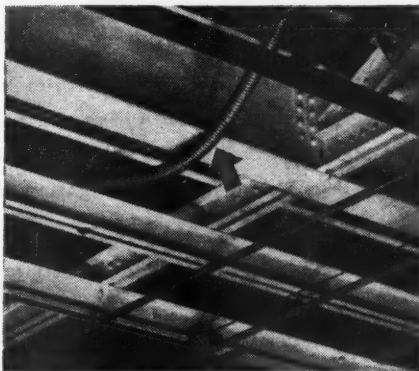
the cable can easily be bent around beams and obstructions. Other plant equipment can be erected immediately without "marking time" while waiting for wire and conduit systems to be put in place.

The initial cost of G-E interlocked-armor cable power distribution systems is frequently 25 per cent lower than for comparable wire and conduit systems, while high salvage



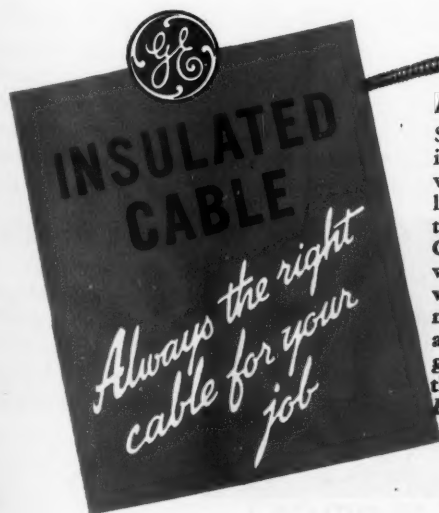
No. 1799 Varnished-Cambric Interlocked-Armor Power Cable (600 volts)

Large structural beams are easily by-passed



value cuts the cost of changing circuits to meet varying load conditions. Important savings of steel and copper are made, and improved voltage regulation due to closer spacing of conductors results in increased machine output.

It will pay you to investigate these and other advantages before wiring new plants, or altering present power distribution systems. Your local G-E representative has the complete story.



V-C INTERLOCKED-ARMOR CABLE—

ANOTHER G-E ACHIEVEMENT RESULTING FROM "FULL-RANGE" RESEARCH

Since the production of General Electric's first varnished-cambric insulation, back in 1901, G-E full-range research has kept abreast with demands for even better insulation. In G-E laboratories it was learned that unfilled cloth was far more permeable than filled, and that the method of varnish application was of great importance. G.E. developed a high-grade, heat-resistant asphalt-base varnish which possessed a number of important advantages. Best oven speeds, varnish viscosities, baking temperatures, and other factors were determined by G-E research. The result is No. 1799, the improved cloth-and-varnish insulation used in G-E interlocked armor cable, with its greater heat-resistance, and power factor and dielectric strength that's better than I.P.C.E.A. requirements. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

501-81-1200

EVERY ADEQUATE LIGHTING JOB *starts with an* ADEQUATE WIRING JOB



Wire it with WIREMOLD



THE years ahead will be LIGHTING YEARS for most electrical contractors . . . and the requirements in new wiring and re-wiring will be at once extensive and widely varied. Jobs will range all the way from architecturally built-in installations to straight lighting of mill type building space.

But no matter what the problem, or what type of fixture and light source is to be used, the chances are that Wiremold will be your "best bet" for the wiring. There are 10 basic Wiremold Systems, each with its complete range of fittings and all interconnectable one with another. These include Wiremold systems and fittings for Fluorescent, Showcase, Strip and Industrial Lighting installations. With Wiremold you are indeed equipped to do a MORE than Adequate Wiring job for the new lighting needs of today and tomorrow.

Write us for the Wiremold Catalog and Wiring Guide, also for New Bulletin covering Wiremold uses.

THE WIREMOLD COMPANY • Hartford 10, Connecticut

Know your

WIREMOLD

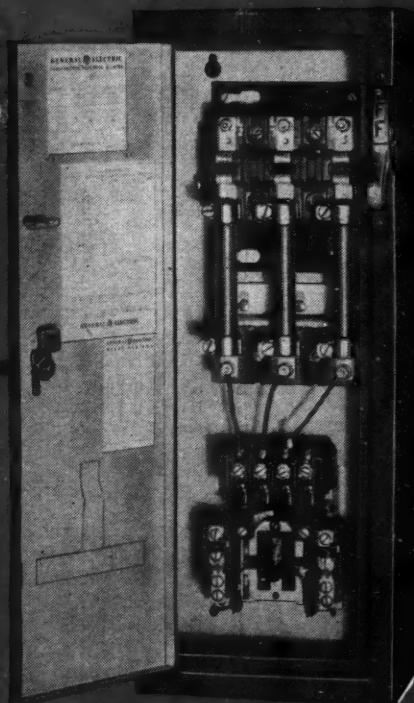
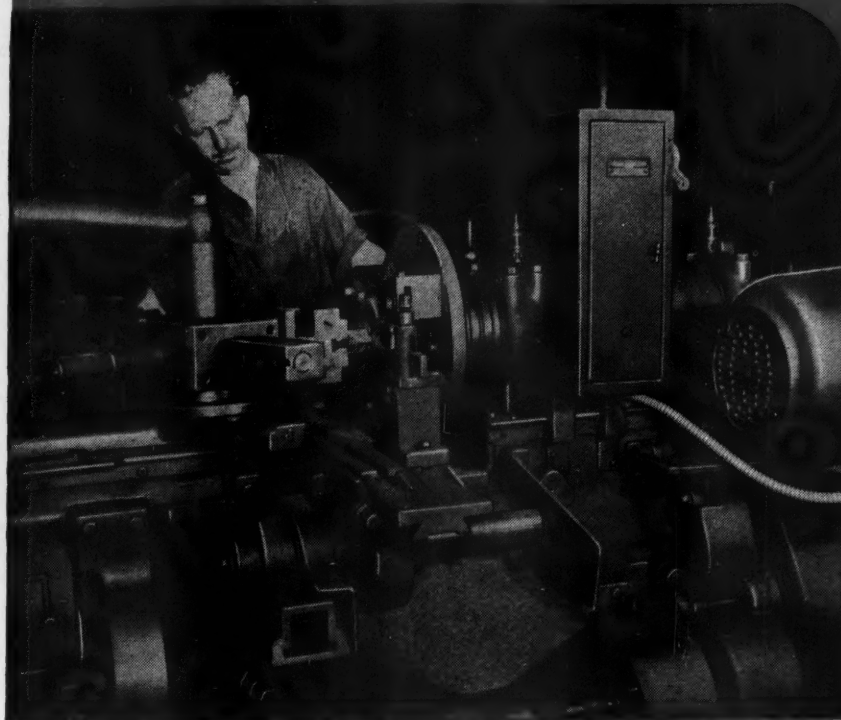
.... MORE THAN ADEQUATE WIRING

FROM PANEL BOX TO OUTLETS



300

G-E COMBINATION MOTOR STARTERS...



...give White Motor Company real protection...save time, money, too.

Magnetic starter and motor-circuit switch in *one* unit—G-E “combination” motor starters of this type give co-ordinated control to over 300 machines in the White Motor Company plant in Cleveland.

The starter shown above is installed on a lathe used in making water pumps. Others control drill presses, shapers, boring mills, grinders, and many other types of machines.

Here's Why the Combination Starter Was Chosen

- Fast-acting overload relays protect the motor controlled from overheating—and fuses protect it from damaging short circuits.
- Safety for operators is assured by interlocking doors. While the power is on, the door cannot be opened.
- Quick servicing and availability of repair parts is made possible by G.E.'s broad network of sales outlets.

Wide Field of Application

This motor company represents just one of the many different industries in which G-E combination starters are at work today. Why not give the advantages of these compact, time-saving starters to *your* plant. Our engineers will be glad to help with your application. Get in touch with our local office today. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL  ELECTRIC
676-200-5910

Electrical Contracting, June 1946

HOW YOU SAVE...

... **TIME.** Instead of buying two devices, you order and install only one. Mounting time is cut as much as 40 per cent.

... **SPACE.** Compact combination starters can be mounted in small unused places near to or remote from the operator.

... **MONEY.** The list price is slightly more than for two separate devices, but the difference is more than made up by savings in wire, conduit, and fittings.

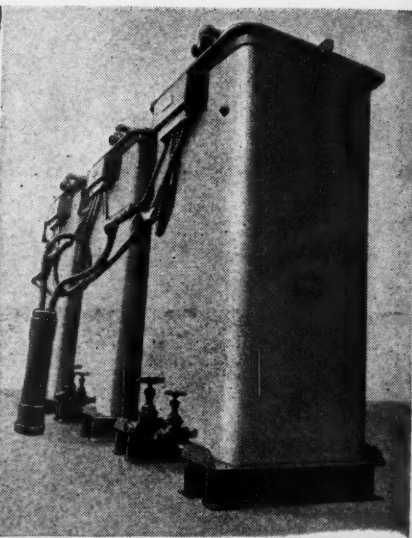
MORE INFORMATION about combination starters is given in our Bulletin GEA-3715A. Ask our local office for your copy.

ACRES of VOLTAGES

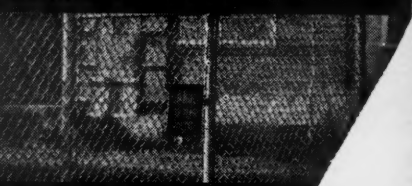
*distributed to
critical chemical
processes*

by

**AMERTRAN
TRANSFORMERS**



Three 150 KVA single phase AmerTran Power Transformers, 2300-440 V.

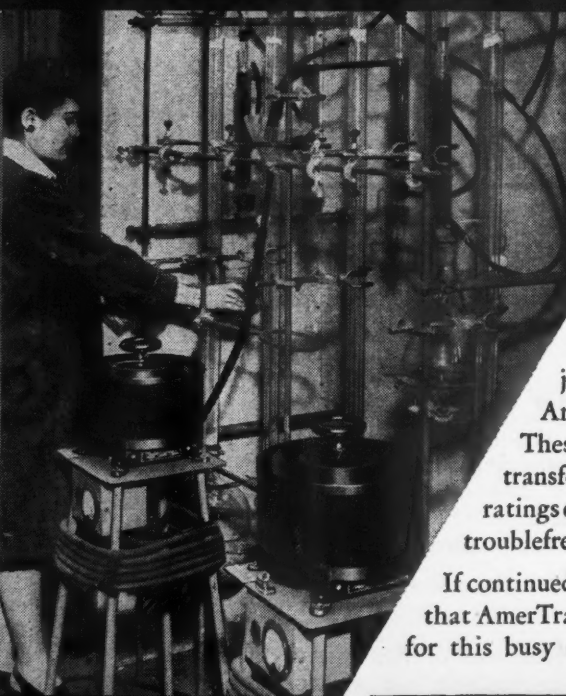


600 KVA O.I.S.C. AmerTran Power Transformer, 3 phase, 2300-440 V.

**GENERAL ANILINE AND FILM CORPORATION
GRASSELLI, NEW JERSEY**



Three AmerTran Dry Type Transformers, used in load balance circuit. Single phase, 440-220 110 V., 25 KVA. Other AmerTran Dry Type units are used for lighting and at-the-load power.



Two heavy duty AmerTran Translats, providing precise AC voltage control for laboratory processes. (There are many more Translats in this plant.)

Miles of distribution lines cover the many acres of plant operations at the huge Grasselli, New Jersey works of this corporation. The first AmerTran installation went into service many years ago. It is on the job today, supported by many other AmerTrans throughout the property. These units range from the main power transformers down through the various ratings of distribution types—to the compact, troublefree, "at-the-load" dry type AmerTrans.

If continued buying means satisfaction, we'd say that AmerTrans are doing a pretty satisfactory job for this busy company. In fact, they told us so!

AMERTRAN

REG. U. S. PAT. OFF.
MANUFACTURING SINCE 1901 AT NEWARK, N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission



AMERICAN TRANSFORMER CO. 178 Emmet St., Newark 5, N.J.



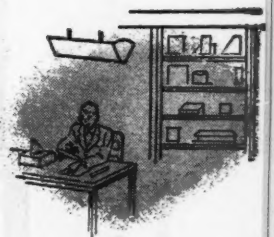
GLASS ENCLOSED LOUVER UNIT

FOR THE MODERN KITCHEN... ... A Housewife's Dream Come True!

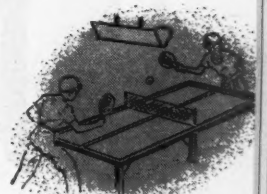
American homemakers want light in their kitchens—lots of it. And Leader's Glass Enclosed Louver Unit (model GL-240) gives 'em what they want. Ideal for other installations, too. In playrooms, workshops, in fact, in any room, this modern two light fixture will add grace and charm to its surroundings.

Leader fixtures are distributed only by better electrical wholesalers.

There is a Leader Representative in your area. See him today, or write

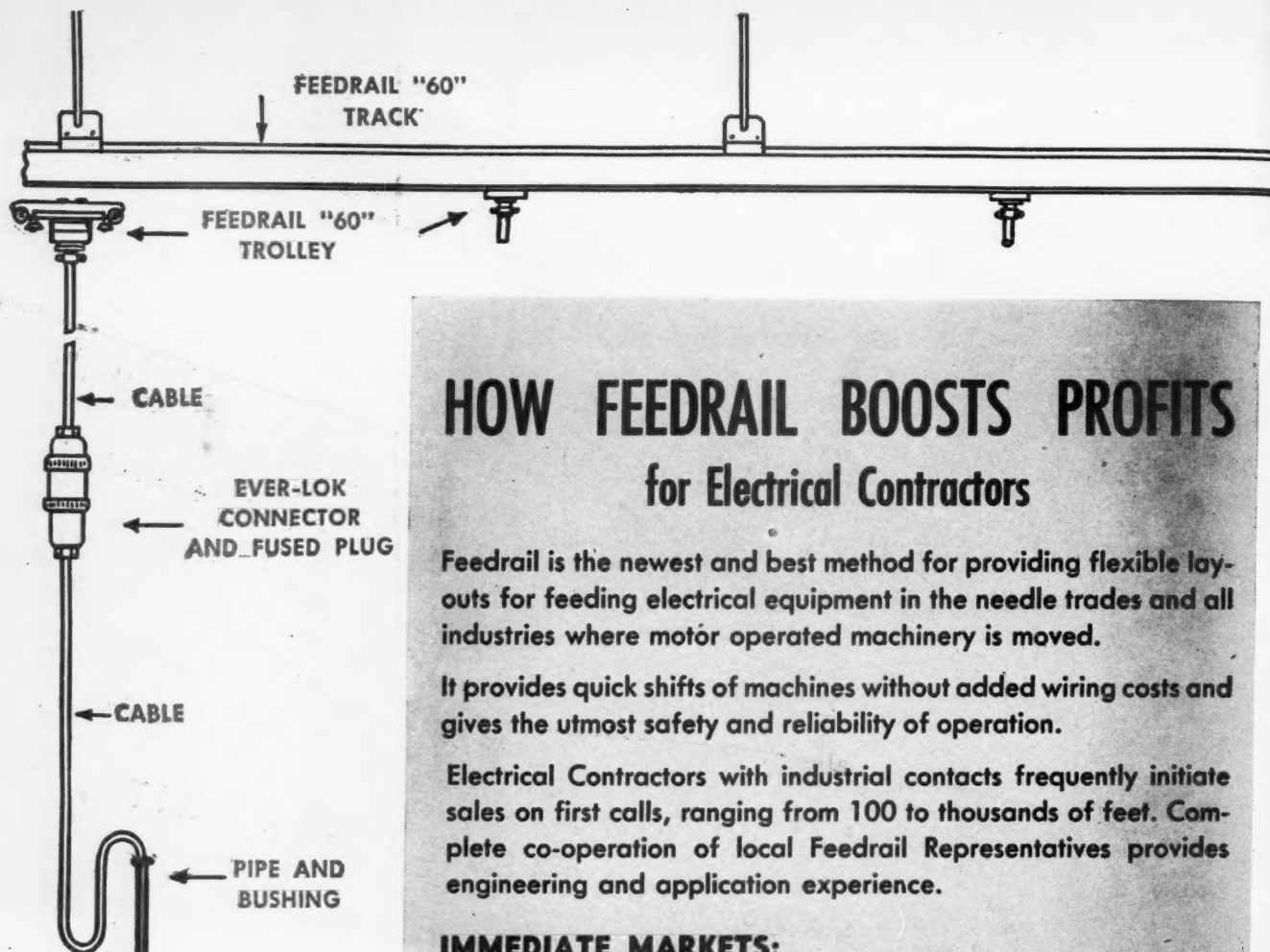


for the workshop



for the playroom

LEADER ELECTRIC MANUFACTURING CORP.
6127 NORTH BROADWAY • CHICAGO 40, ILLINOIS
WEST COAST FACTORY • 2040 LIVINGSTON STREET • OAKLAND, CALIFORNIA



HOW FEEDRAIL BOOSTS PROFITS for Electrical Contractors

Feedrail is the newest and best method for providing flexible lay-outs for feeding electrical equipment in the needle trades and all industries where motor operated machinery is moved.

It provides quick shifts of machines without added wiring costs and gives the utmost safety and reliability of operation.

Electrical Contractors with industrial contacts frequently initiate sales on first calls, ranging from 100 to thousands of feet. Complete co-operation of local Feedrail Representatives provides engineering and application experience.

IMMEDIATE MARKETS:

Needle Trades—for sewing and cutting machines;

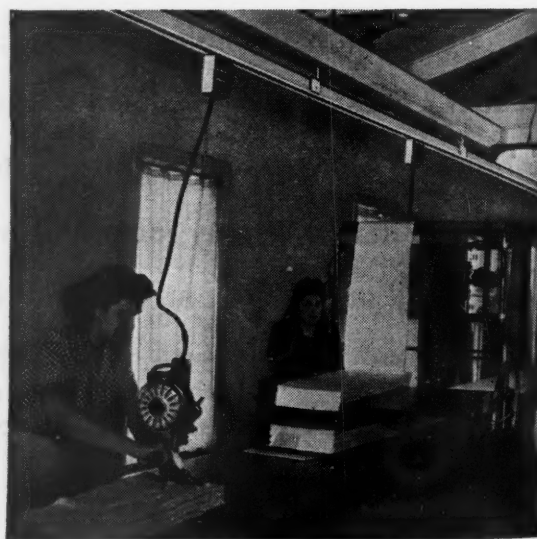
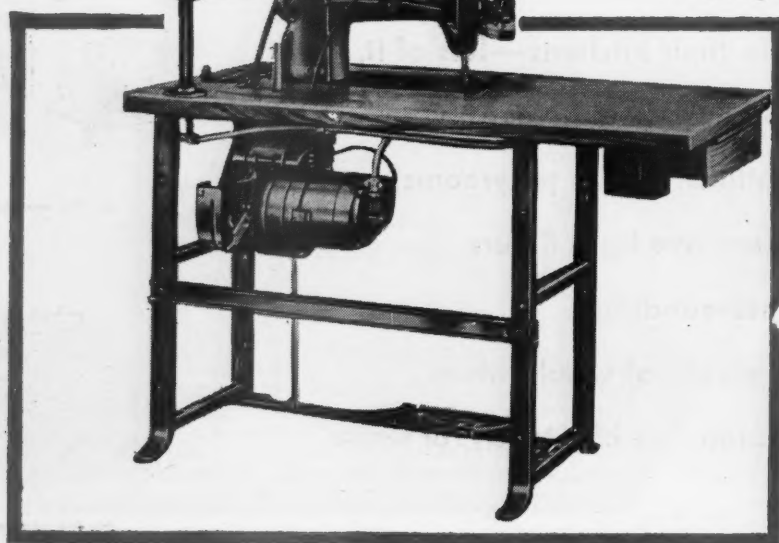
Industrial Plants—for portable tools, test lines, cranes and hoists

The following catalogs are available: General No. 15, Needle Trades No. 16, Machine Tools No. 17

F E E D R A I L C O R P O R A T I O N

Subsidiary of Russell & Stoll Co., 125 BARCLAY STREET, NEW YORK 7, N. Y.

FEEDRAIL is handy for cutting machines—particularly over long tables. The trolley moves along with the machine. Note the moving cloth laying machine with inspection light on FEEDRAIL



PANTHER and DRAGON TAPES

DEFY

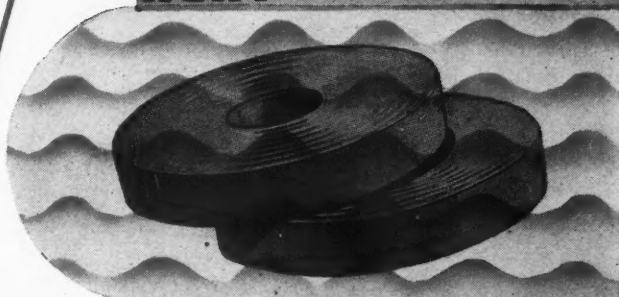
*W*rapped and *sealed* individually in cellophane, PANTHER and DRAGON Tapes are safe in any climate. They "work" well and last on the job.

These well-known tapes are made and backed by the company which has specialized for over 65 years in insulating electrical wires and cables.

PANTHER and DRAGON Friction Tapes adhere firmly, meet ASTM adhesion requirements. PANTHER and DRAGON Rubber Tapes fuse readily and securely, have high elongation and excellent dielectric qualities and meet ASTM tests for tensile strength. All tapes pass Federal Emergency Specifications.

Most independent wholesalers can supply you with these tapes and further details about them. If your jobber cannot, please write direct.

HEAT



COLD



MOISTURE



**...and will last
on the job**



**PANTHER AND DRAGON
friction & rubber TAPES**

Sold Through Recognized Independent Wholesalers



**HAZARD
INSULATED WIRE WORKS**

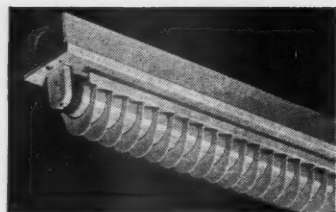
Division of The Okonite Co.

Wilkes-Barre, Pennsylvania • Offices in Principal Cities

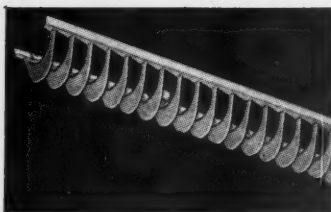
4528

FLUOR-O-SHIELD*

LIGHT DIFFUSER FOR FLUORESCENT LAMPS



No glare from any angle. Casts no shadows. Fluor-O-Shields do not catch dust or dirt.



Snap-on clips for instant attachment or removal without bolts, screws or tools.



No time lost for installation. Just snaps on. Shipped ready for immediate attachment.

...means better lighting at lower cost!

Better lighting means more efficient work, more sales, and improved conditions for store displays, production lines and office layouts. And, Fluor-O-Shield diffuses fluorescent light evenly, eliminates glare and minimizes stroboscopic effect. Lower cost because Fluor-O-Shield is a simple, one-piece louver that is instantly attached or removed, available in two sizes (40W and 20W), is equally suitable for continuous or unit mounting. Of lightweight aluminum, white baked enamel, Fluor-O-Shield causes no stress or strain on lamps or sockets.

SALES-SLANT for DEALERS: Take note of the profitable business immediately possible selling Fluor-O-Shields as a multiple item with fluorescent lamps and starter replacements. Fluor-O-Shields require small stock space and are rapid turn-over items. A single demonstration of the advantages of Fluor-O-Shield can result in countless sales to plant, factory and store owners.

Fluor-O-Shields are available in sizes for 40W and 20W fixtures and are shipped ready for immediate attachment. If your distributor does not stock Fluor-O-Shields, ask him to write us.

• Eliminates Glare • Decorative • Instantly Attached • Fits Most Open-Lamp Fluorescent Lamp Fixtures • For Factory, Store, Office and Home Lighting • Of Durable, Lightweight Aluminum, finished in White Baked Enamel.

SPECIFICATIONS

Cat. No.	Length	Fits Lamp	Units Per Pkg.
27-1-40	46 $\frac{3}{8}$ in.	40 watt	12
27-5-40	22 $\frac{3}{8}$ in.	20 watt	12

\$1.95

40 Watt—46 $\frac{3}{8}$ in.

\$1.25

20 Watt—22 $\frac{3}{8}$ in.

*Trade Mark—Patent Pending

FLUOR-O-SHIELD* by CAMFIELD MANUFACTURING COMPANY • GRAND HAVEN, MICHIGAN



"And who in the Div'l is Raco?"

That's easy, officer, Raco is a trade-marked line of All-Steel-Equip Co. . . . the complete line of steel switch boxes and outlet boxes that has won the approval of architects, builders and contractors throughout America!

HERE'S WHY YOU, TOO, SHOULD INSIST ON THE RACO • ALL-STEEL • LINE . . .

CLEAN—Smooth, lustrous finish. No dirt, no grease, no chipping or flaking paint, and no rough edges.

PACKAGED—Every Raco product comes to you in attractive cartons . . . with easy-to-read index showing product number, quantity and finish.

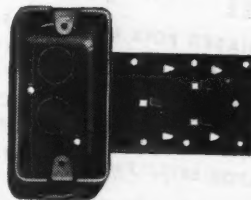
UNIFORM—All Raco Products are made to the same exacting standards as other precision metal products that All-Steel has been manufacturing for more than 33 years.

And in addition, Raco • All-Steel • Line is sold *nationally through wholesalers only*. It's the quality line, the dependable line. Look for the Raco trade-mark . . . the sign of better workmanship.



← 400 1/2-O—STANDARD (UTILITY) BOX. Enam-
eled or galvanized finish. With "Side-Mount" Bracket.

400 1/2-B—STANDARD (UTILITY) BOX. Enameled
or galvanized finish. With "Face-Mount" Bracket. →



ALL-STEEL-EQUIP COMPANY, INC.
600 Kensington Avenue, Aurora, Illinois

RACO • ALL-STEEL • PRODUCTS
SWITCH BOXES • OUTLET BOXES

No Secrets Here



PERFORMANCE PROVES THE VALUE OF THESE TESTS

... and motor users profit!

Efficiency. Power factor. Speed. Yes, and temperature rise, too! This comprehensive laboratory dynamometer test is one of the many that all R & M motor designs must pass before you ever see them.

Performance is checked over the full operating range—to 25% overload . . . 50% overload! Output is measured against input, as temperature readings at many points on windings and frame are recorded. It's no wonder R & M motors are so dependable and durable—so "sweet" and smooth.

Fine motor building means fine motors—capable; even tempered; trained to take responsibility, *whatever* it may be. With their record of nearly fifty years of problem-solving, R & M motors represent an accumulated knowledge that can help you, as it has so many others.

FREE NEW BOOKLETS!

"SHADED POLE MOTORS," Form No. 1887. "MATCHED MOTOR PARTS," Form No. 1871. "UNISHELL INTEGRAL H.P. MOTORS," Form No. 1845. "MOTOR GENERATOR SETS," Form No. 1881.

Send for any or all of these booklets, now.

ROBBINS & MYERS • INC. MOTOR DIVISION • SPRINGFIELD, OHIO
In Canada: Robbins & Myers Co., of Canada, Ltd., Brantford, Ont.

MOTORS • HOISTS • CRANES • MACHINE DRIVES • FANS • MOYNO PUMPS • FOUNDED 1878

THESE FACTS SHOW *Why* . . .

G-E Thermoplastic

BUILDING WIRE

answers your wiring needs

New Wiring • Rewiring
Maintenance Wiring

Description . . . G-E thermoplastic building wire (Types T and TW) is a small diameter wire made of highest quality materials and produced to meet rigid specifications. It can be used for all wiring requirements where permitted by local codes and is suited for widely varying service conditions.

Physical Properties . . . G-E thermoplastic building wire resists oils, acids, alkalies, and other chemicals and solvents. It is virtually unaffected by sunlight, moisture and weathering. It resists flame and will not support combustion.

Electrical . . . G-E thermoplastic building wire is high in dielectric strength and will withstand a 720-volt per mil breakdown voltage. Current carrying capacity ranges from 18 amperes for size 14, to 455 amperes for 1000000 CM (based on National Electric Code). High insulation resistance eliminates the danger of loss of power due to current leakage. Types T and TW wires can be used wherever Types R, RL, and RW are acceptable.

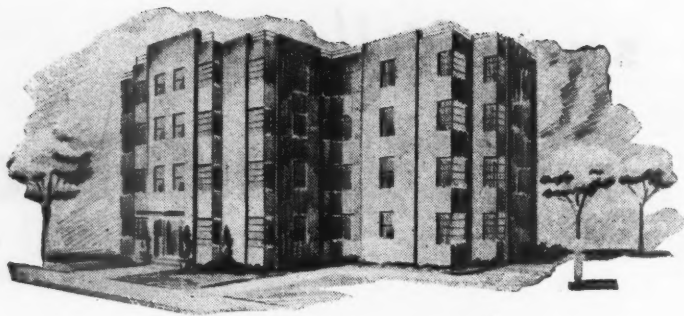
Insulation . . . G-E thermoplastic building wire is insulated with plasticized polyvinyl chloride compounds which give it unusual resistance to aging, abrasion, and extremes of temperature. The insulation has a hard, smooth finish.

Types . . . Types T and TW building wires are suitable for new wiring, rewiring, maintenance wiring, and special wiring. Type T is recommended where general-purpose wiring is suitable. Type TW is recommended for service in permanently wet locations.

Information . . . Ask your nearest G-E Merchandise Distributor or write to Section W661-8, for additional data on physical and chemical characteristics, sizes, typical applications, etc. General Electric Company, Appliance and Merchandise Department, Bridgeport, Connecticut.

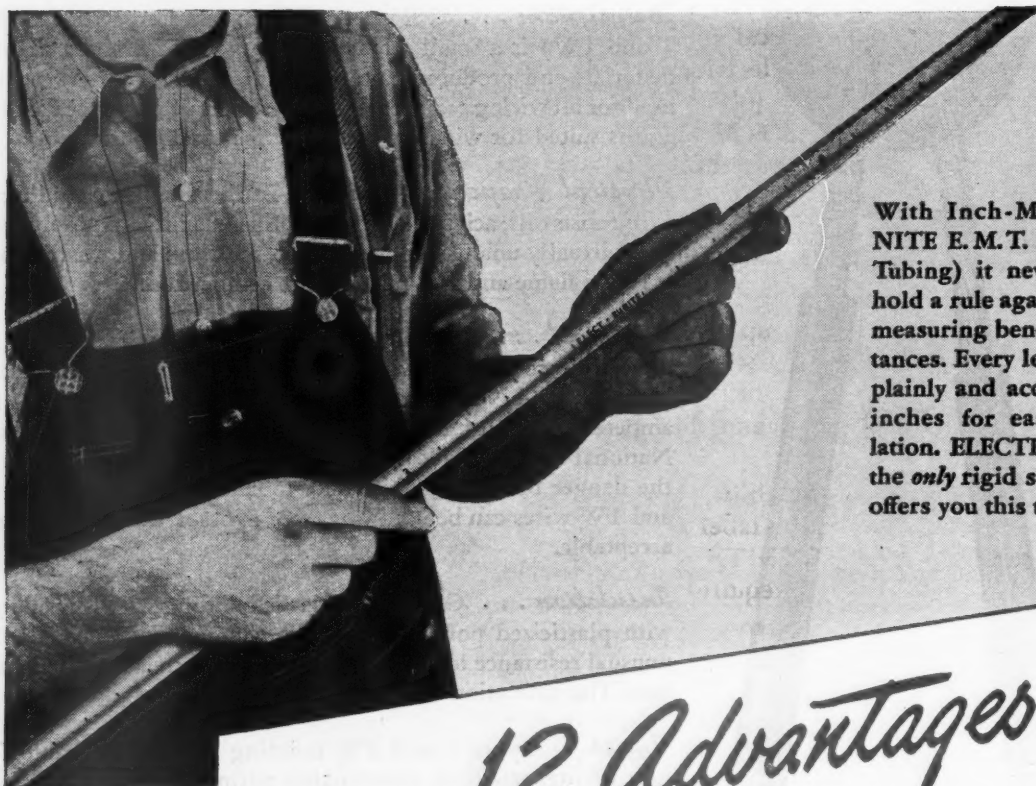


GENERAL  ELECTRIC



FOR APARTMENT WIRING

The Modern Way is



With Inch-Marked ELECTRUNITE E. M. T. (Electrical Metallic Tubing) it never is necessary to hold a rule against the conduit for measuring bending or cutting distances. Every length is marked off plainly and accurately in feet and inches for easier, faster installation. ELECTRUNITE E. M. T. is the *only* rigid steel raceway which offers you this time-saving feature.

12 Advantages

1. FULL PROTECTION

2. NO THREAD-CUTTING

3. INCH-MARKING

4. LIGHT WEIGHT

5. EASY TO BEND AND REBEND

6. STANDARD FITTINGS

7. EASY TO INSTALL

8. UNBROKEN CORROSION-RESISTANCE

9. KNURLED INSIDE SURFACE

10. UNIVERSAL ACCEPTANCE

11. LOW COST

12. WIDESPREAD DISTRIBUTION

The Electrunité Way

... Streamlined **ELECTRUNITE E. M. T.**
keeps wiring costs down... Provides
full **Electrical and Mechanical Protection**

For wiring raceways that are economical and easy to install . . . that provide adequate electrical and mechanical protection throughout the job . . . you can't beat Republic **ELECTRUNITE E. M. T.**—the modern, lightweight rigid steel raceway that ends dirty, tedious thread-cutting.

With **ELECTRUNITE E. M. T.**, there are no plumbing tools to lug around . . . no time lost cutting threads . . . and no need to turn long lengths of tubing. Simple compression-type couplings and connectors make strong, water-tight joints in a hurry. You slip the fitting on the end of the tube, tighten it with an open end wrench, and the job is done. It's as simple as that!

Your assurance of safety and dependability is the Underwriters' Laboratories inspection label which appears on every length of **ELECTRUNITE E. M. T.** This up-to-date conduit meets all UL requirements. **ELECTRUNITE E. M. T.** is approved, too, by The National Electrical Code for exposed, concealed and concrete slab construction.

For complete information about Republic **ELECTRUNITE E. M. T.** and its many money-saving advantages, see your nearest **ELECTRUNITE** Distributor or write directly to:

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York



*On the job . . . or in the shop . . . all types of bends, snags and offsets can be made with predetermined accuracy when you use the patented one-piece **ELECTRUNITE Bender and Inch-Marked*** **ELECTRUNITE E. M. T.**—the streamlined electrical raceway. (*Reg. U. S. Pat. Off.)*



Republic
ELECTRUNITE E. M. T.
REG. U. S. PAT. OFF.

LIGHTWEIGHT THREADLESS RIGID STEEL RACEWAY

FOR SAFETY'S SAKE . . . USE CONDUIT (*Full Weight Rigid Steel*)



This system of Buckeye conduit, installed in a large department store a generation ago, still provides dependable wiring protection to owners and tenants.

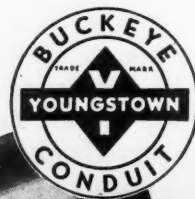
RACEWAYS to lasting safety

WHEN you're planning wiring systems for the buildings of tomorrow, safety is naturally a first consideration. Not only safety, but *permanent* safety!

The electrical industry has long since agreed--and incorporated it in the national code--that the one safest system for the lasting protection of electrical wiring is that employing heavy-wall steel conduit. This is the only system approved for use in hazardous locations and occupancies, as being dependably moisture, vapor, dust, and explosion proof.

So for positive protection, install permanent raceways of full-weight, rigid steel conduit--"Buckeye" conduit. Wiring is easily changed to meet changing day-to-day needs, yet the conduit remains in place, as raceways to lasting safety.

Youngstown "Buckeye," the world's most widely used standard-threaded, full-weight, rigid steel conduit, is sold by leading distributors in all markets.



YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

GENERAL OFFICES - YOUNGSTOWN 1, OHIO

Export Offices - 500 Fifth Avenue, New York City

Manufacturers of

CARBON - ALLOY AND YOLOX STEELS



Ask your distributor for:

Youngstown Buckeye Conduit...Pipe and Tubular Products...Sheets...Plates...Electrolytic Tin Plate...Coke Tin Plate...Bars...Rods...Wire...Tie Plates and Spikes.

Are Heating Profits Slipping Through Your Fingers?

READ THESE FACTS ABOUT THERMADOR ELECTRIC HOME HEATING

Outstandingly different, supremely modern and rich in advantages over ordinary heating systems, Thermador electric heating provides a newsworthy story for both you and your home-owner customers.

THERMADOR ELECTRIC WARMTH IS CLEANER, PURER, SAFER

Thermador units offer the incomparable benefits of electric warmth in any room you desire. That means clean, pure, fumeless warmth...warmth that doesn't consume the vital oxygen in the air nor leave dust and film and smudges on the draperies, furniture and walls. For in electric heating nothing's added, nothing's removed. Room air is passed over an electric element, heated and spread over the living zone to give healthful, luxurious warmth.

And it means safe, anxiety-free warmth...warmth that is derived from heating units that are fully protected with no exposed flames to blow out or to tempt curious little fingers.

THERMADOR ELECTRIC WARMTH IS MORE ECONOMICAL

Thermador electric heating is a decentralized system. Each room has one or more independent units operated either manually or thermostatically. These units are compact, prefabricated...fit snugly into any wall between ordinary struts with a minimum of construction. No costly flues, chimneys or pipes are needed...no cellar space is required. They are as adaptable to a home being remodeled as to one being built anew.

Since each unit is operated independently, there's no central heating plant to be turned on during the seasons when just a little added warmth is required for a particular part of the home. Just a flip of the switch and baby's nursery, the bathroom or den is quickly warmed without wasting precious heat over the entire house.

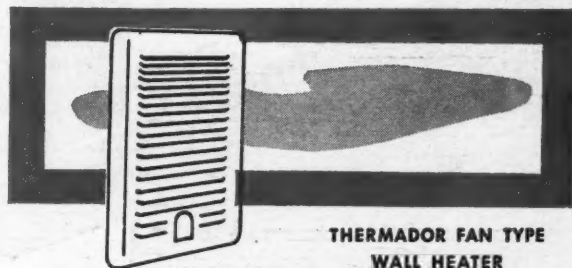
THERMADOR ELECTRIC HOME HEATING IS FAR MORE EFFICIENT



THERMADOR HEAD-TO-HEELS
BATHROOM HEATER

Thermador utilizes new, original applications of electric heating principles to provide a maximum of heating efficiency. Consider the famous Thermador Head-to-Heels Bathroom

Heater. Unconventional in appearance?...Yes, and far more effective in the way it warms. For the Head-to-Heels is a tall, slender, handsomely finished unit that fits flush into any



THERMADOR FAN TYPE
WALL HEATER

bathroom to provide instant, *overall* warmth. Its unusual design is no accident...but a scientific development that Thermador originated for greater bathroom heating efficiency.

And for every room in the home there's the equally famous Thermador Fan Type Wall Heater. Just as the Head-to-Heels employs a greater radiant length for quicker, overall warmth, so does this Fan Type Heater present a new and different application for the job it is designed to perform. Built into the unit is a fan that *forces* a gentle stream of clean, warm air out and down into the living zone.

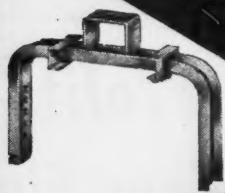
MAKE THIS TEST

Stand in front of an ordinary convection heater. You'll hardly feel the warmth. Yet place your hand above it and you can feel the heat rushing up to the wasted areas near the ceiling. Now stand in front of a Thermador...enjoy the caressing warmth that is forced out by the fan all over the living zone. What's more, in summer, switch off the heating element and the fan itself circulates cooling breezes throughout the home.

Thermador electric home heating offers you an outstanding opportunity for additional profits. Whether your customers are building or remodeling, it will pay you to tell them about Thermador electric heating. For further information, write, wire or phone Dept. EC-6



THERMADOR ELECTRICAL MFG. CO. • 5119 District Blvd., Los Angeles 22



Not just lighting - but Ceilings Unlimited

THE MILLER FLUORESCENT TROFFER LIGHTING SYSTEM for stores, offices, schools, factories, and public buildings is an important advance in lighting. The backbone of this system is the patented Miller Ceiling Furring Hanger which suspends ceilings from the lighting system - does away with laborious fitting of recessed lighting into hung ceilings, cuts needed supports from structural ceiling 50 to 75%. Has its own wireway which reduces wiring costs up to 50% . . . conduit and conduit fitting costs up to 80%.

MILLER FLUORESCENT TROFFER LIGHTING SYSTEMS provide not just lighting - the best seeing light - but provide the means for interior improvement - CEILINGS UNLIMITED.



THE MILLER COMPANY • MERIDEN, CONN.

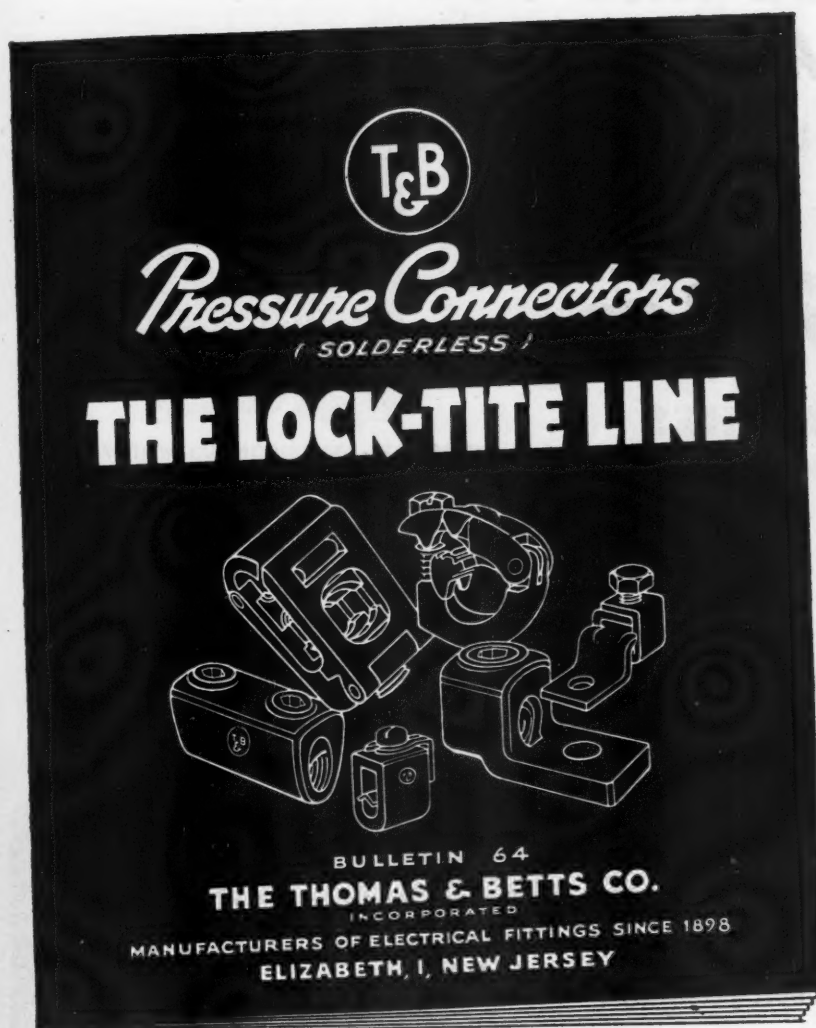
Illuminating Division

• HEATING PRODUCTS DIVISION
• ILLUMINATING DIVISION

• ROLLING MILL DIVISION
• FOUNDRY DIVISION

The WORKS!

THIS NEW BULLETIN TELLS YOU
WITH WHAT AND HOW
TO HANDLE **ALL** OF YOUR
STANDARD WIRING JOBS



Simplifies your selection of Pressure Connectors which have been Approved by the Underwriters Laboratories, for your jobs.

Gives engineering facts and test data.

Illustrates ease of installing "Lock-Tite" Pressure Connectors.

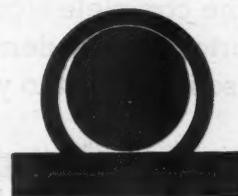
Shows how each compact, easy-to-tape Lock-Tite Connector is engineered to take a wide variety of overlapping cable sizes, making them economical to stock.

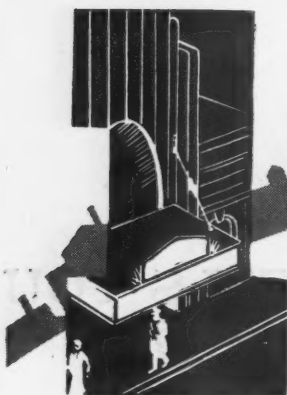
Gives catalog information on what and how to order.

Shows recent developments of T&B Laboratories.

You will get the most out of this new Bulletin 64 if you are an Electrical Contractor, an electrician in industrial plants, an electrical engineer for a railroad or utility, a maintenance and repair man who handles wiring, a purchasing agent who knows values and buys the best.

For your copy, write The Thomas & Betts Co., Elizabeth 1, New Jersey. Or get it from your nearby T&B Electrical Wholesaler through whom, under The T&B Plan, all T&B products are distributed exclusively.





Advertising
LIGHTING INSTALLATION



General
LIGHTING INSTALLATION



Protective
LIGHTING INSTALLATION

ALL THREE ARE COMPLETE INSTALLATIONS

ALL THREE ARE EQUIPPED WITH

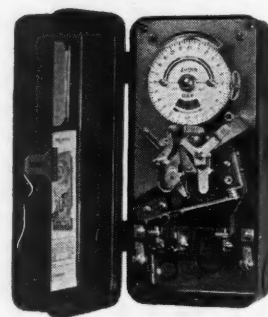
Sangamo

TIME SWITCHES

HERE is your opportunity for extra sales—extra installations—extra profits. SANGAMO TIME SWITCHES give your customers accuracy for "on" and "off" times—and it doesn't take long for any customer to see how this AUTOMATIC CONTROL is most beneficial.

Every "General," "Advertising," or "Protective" lighting installation, when equipped with SANGAMO TIME SWITCHES performs without error in timing. The reliability of this AUTOMATIC CONTROL has been proved in thousands of installations.

Ask us about SANGAMO TIME SWITCHES—get the complete story—see why they are so important in modern lighting installations and so important to you with regard to profit.

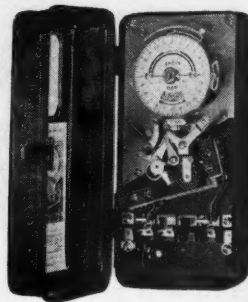


FORM KAZ—SYNCHRONOUS MOTORS
SILVER CONTACTS

Six levers are provided for a maximum of 3 daily "on" and "off" operations. Accurate timing is obtained by turning the minute hand reset staff on the 24 hour dial. If desired the time-switch can be manually operated without affecting subsequent operations. Available in a wide variety of combinations providing two-circuits, duplex, and outdoor switches; also with Sunday and holiday omitting device, as well as advance time cutoff. The KAZ Astronomic Dial Time-Switch functions to close the circuit at sunset and open it at sunrise, or the "off" operation may be set at any time between 9:30 P.M. and 2:15 A.M.

FORM VSWZ
SYNCHRONOUS MOTOR
WITH CARRYOVER

Synchronous timing is combined with reserve spring clock operation, providing continuous operation during current interruptions up to ten hours. This entirely automatic carry-over eliminates the necessity of re-setting the dial after current interruptions, and insures accurate timing under all conditions. Equipped with Astronomic Dial.



ASTRONOMIC DIAL: Both of the Sangamo Time Switches shown here are equipped with Astronomic Dials. These dials enable "on" and "off" operations in accordance with sunset and sunrise.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

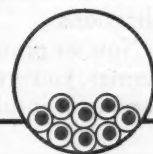
FEDERAL engineering gives you *The Latest and Finest in* **PLASTIC INSULATED BUILDING WIRE**

Type T thin-wall PVC insulated wire with high resistance to HEAT, COLD, OXIDATION, OILS, ACIDS, CHEMICAL FUMES, MOISTURE!

From the same laboratories that have pioneered so many advances in communication cable design, comes this Federal Type T wire. It is your assurance of building wire *engineered* for the finest possible job.

Rigidly controlled during manufacture, Federal's Type T is also tested to highest underwriter standards. In general wiring, it serves with utmost reliability. It strips freely, leaving copper clean for splicing . . . pulls through conduit easily . . . resists abrasion . . . doesn't support combustion.

And in underwired buildings, Federal's wire works wonders . . . permitting more conductors per unit area of conduit, maximum loads to be carried, more circuits to be installed. Check your needs in Type T building wire. It's available now in a wide range of sizes. Write for particulars.

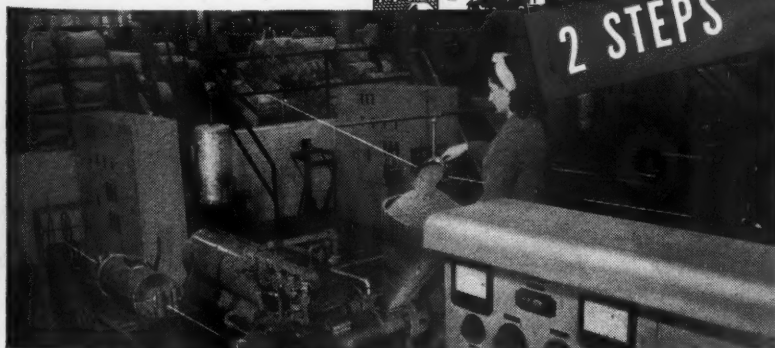


MORE WIRES IN A CONDUIT

Thin insulating wall on Federal Type T wire permits greater portion of conduit space to be occupied by conductors. Use this type in your new wiring jobs for maximum load capacity. And in underwired buildings, you can appreciably increase power carried by these additional circuits!



**2 STEPS . . . IN FEDERAL WIRE
IMPROVEMENT!**



The finest quality, proved materials are used in Federal wire manufacture. Here, insulation material is being fed to the extrusion machine. Wire emerges from this machine *exactly* as designed . . . built for the job.



Dimensional precision controlled by frequent checks as it comes from extruder. Federal wire is uniform, from one end to the other.

Federal Telephone and Radio Corporation

Export Distributor
International Standard Electric Corporation

Newark 1, New Jersey



Latest developments

U·S·S American Electrical

MANY notable improvements have been made in electrical wire and cable during the past few years. The accompanying illustrations exemplify some of the more recent developments in which better engineering at the American Steel & Wire Company has resulted in superior electrical wire and cable for both standard and special applications.

Now we proudly offer more weather-resistant coverings, jackets and finishes; greater immunity of conductor insulation and lead sheaths to chemi-

cal soil actions; synthetic rubber; natural rubber; resin; asbestos; varnished cambric and paper insulations; all with better heat resistance and improved over-all electric characteristics.

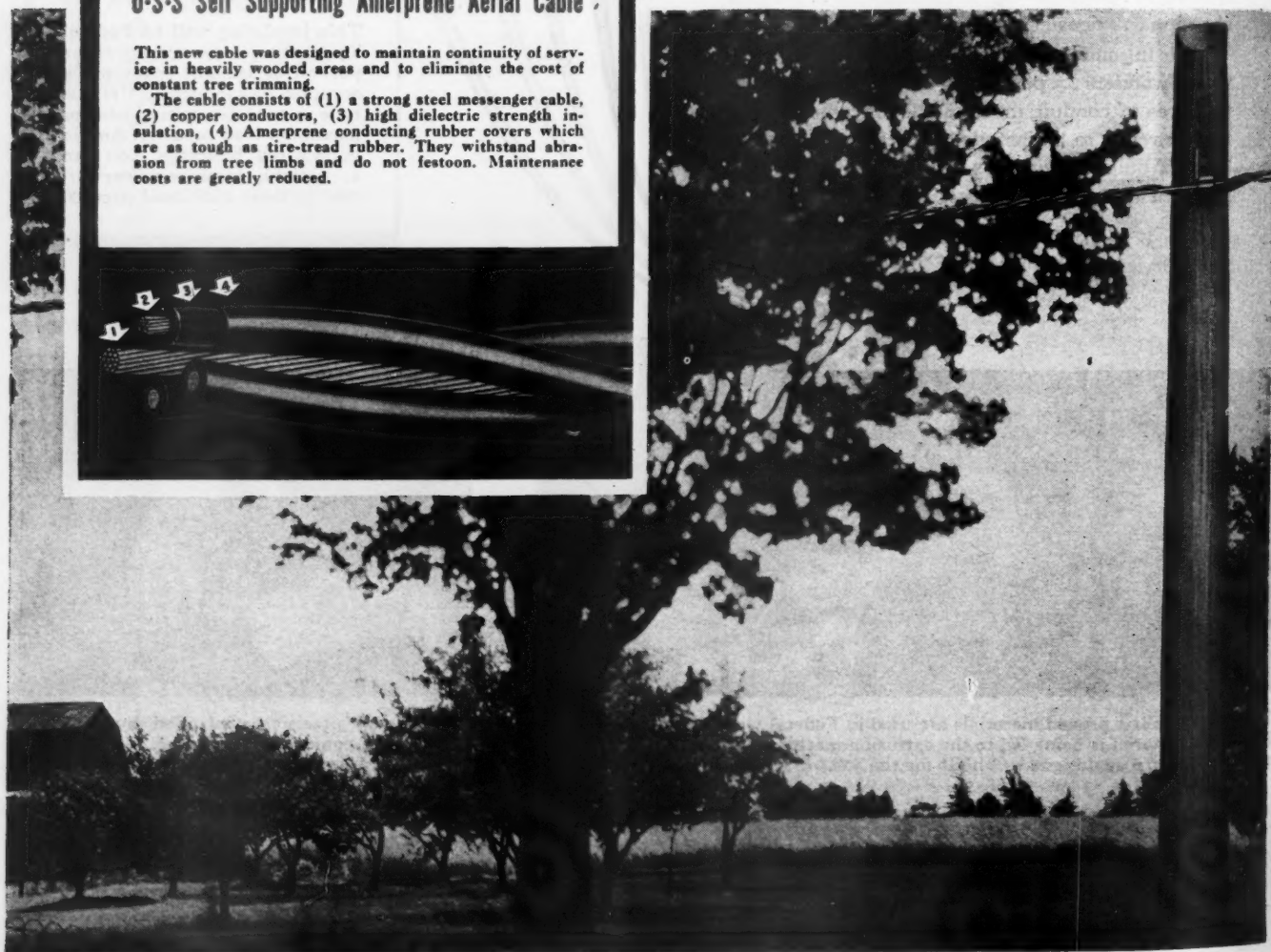
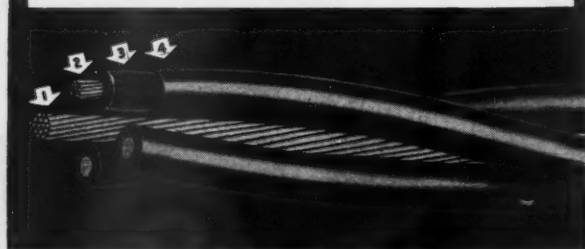
Newly designed supports, dead ends, and other accessories further enhance the life of overhead power and signal conductors.

No matter what type of wire or cable you need, you'll find that American Steel & Wire Company either makes it or will design it to fit your particular needs. Write for specific information.

U-S-S Self Supporting Amerprene Aerial Cable

This new cable was designed to maintain continuity of service in heavily wooded areas and to eliminate the cost of constant tree trimming.

The cable consists of (1) a strong steel messenger cable, (2) copper conductors, (3) high dielectric strength insulation, (4) Amerprene conducting rubber covers which are as tough as tire-tread rubber. They withstand abrasion from tree limbs and do not festoon. Maintenance costs are greatly reduced.



in

Wire and Cable

*Engineered
to fit the job!*

U-S-S Ampyrol Synthetic Resin Insulated Wire

Designed primarily for a thin walled building wire which would permit greater current carrying capacity in a conduit of given size. Ampyrol insulation has high dielectric strength and resists practically every known destructive force encountered by electrical wire—moisture, oil, acids, alkalis, flame, ozone, sunlight, age and mechanical failure. These qualities have made Ampyrol popular for building wire, switchboards, control wiring, radio and other applications.



PS Shielded Varnished Cambric Cable

The use of semi-conducting tape as an improved method of shielding power cable is a recent development of American Steel & Wire Company research laboratories. It has proved highly successful in eliminating air gaps and consequent spark discharges with attendant corona and ozone formation. These improved U-S-S Varnished Cambric Cables can be used at higher voltages and at higher temperatures.



PC Pressure Compensated Paper Cable

Designed to handle heavy loads at higher temperatures, this cable keeps internal pressure from building up above prescribed limits. It has three gas-filled tubes included in its assembly, perforated at intervals to allow the oil compound to be forced into the tubes as the cable heats up under load. This compresses the gas and prevents development of excess pressures.



U-S-S Amerductor and P.F.T. Armor Rods FOR RURAL ELECTRIFICATION

This combination results in a stronger rural line with high conductivity which can be installed at low cost. U-S-S Amerductor consists of two galvanized copper conductors and one high-strength galvanized steel wire. P.F.T. Armor Rods give superior protection at the supports and practically eliminate outages caused by vibration, flash-over, pitting, burns, chafing and mechanical damage.



AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, Pacific Coast Distributors
Tennessee Coal, Iron & Railroad Company, Birmingham, Southern Distributors
United States Steel Export Company, New York

UNITED STATES STEEL

U-S-S American Electrical Wire & Cable



THE Luminaire IS THE KEY TO GOOD LIGHTING



Guth FLUORESCENT

THE "KEY" TO THE SPECIFIC LIGHTING JOB!

Whatever the lighting problem, whether in office, store, factory or institution, the "Key" to Good Lighting is the Luminaire, for it is the Luminaire that harnesses and controls the energy of the light sources to produce the desired results!

GUTH FLUORESCENT Luminaires are the "Key" to the Specific Lighting Job. The complete line of

GUTH FLUORESCENTS is engineered to provide the quantity and quality of light you require for any specific installation. GUTH FLUORESCENTS offer "tested" quality, proven in actual application, dependable results, predictable by scientific ratings, and the newest Luminaire designs, pioneered by GUTH—Leaders in Lighting for 44 continuous years.

*DATA ON THIS PHOTO: GUTH RECESSED TROFFERS in this Public Library are providing 59 Foot Candles of quality illumination, mounted in 10' ceiling, and requiring only 3 watts per square foot.

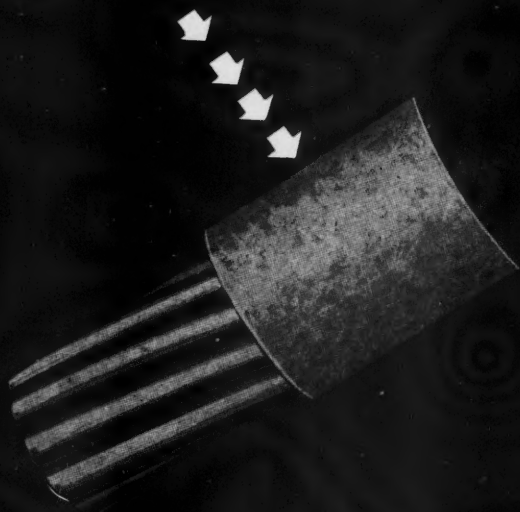
2615 WASHINGTON AVE.

THE EDWIN F. GUTH CO.
LEADERS IN LIGHTING SINCE 1902

ST. LOUIS 3, MISSOURI

National Electric

ASBESTOS WIRE AND CABLE



Resists heat, moisture,
oil, grease, fumes . . .

2 TYPES

For All HOT-SPOT Locations

1. ALL-ASBESTOS

Sizes 18AWG to 1,000 MCM. 300 & 600-volt ratings. Max. operating temperatures: 200°C(392°F) and 125°C (257°F) respectively.

FOR wiring rheostats, electric ranges, electric water heaters, switchboards and electrical equipment exposed to heat or fire hazards, and general open wiring in hot locations.

2. ASBESTOS-VARNISHED CAMBRIC

Sizes 18AWG to 1,000 MCM. 600 to 8000-volt ratings. Max. operating temperatures: 110°C(230°F) for 600-volt wire to 91°C (196°F) for 8000-volt wire.

FOR power circuits and general hot-spot wiring in boiler rooms, power plants, steel mills, steam tunnels, etc.

Write for your copy of "NEasbestos Wire for Hot Spots."

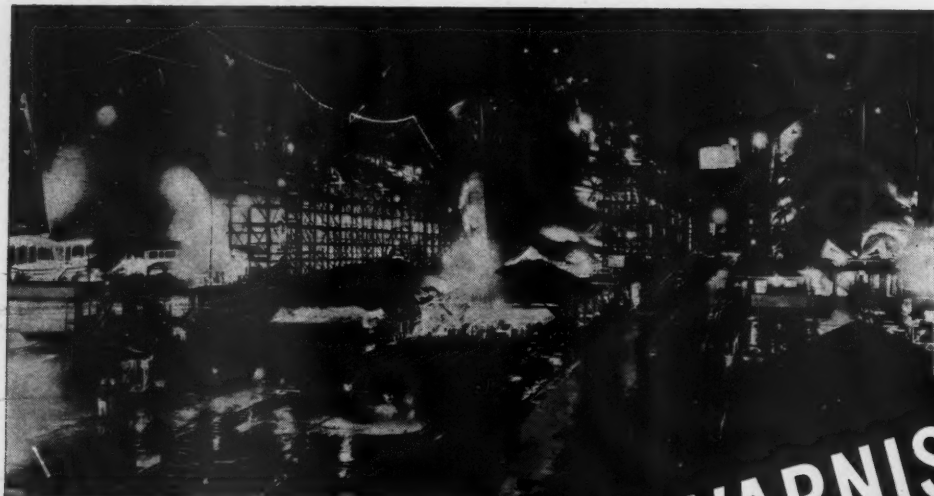
Address: National Electric Products Corporation,

Box 897, Pittsburgh 30, Pa.

National Electric Products Corp.
Pittsburgh, Pa.



No electrical equipment can be any better than its insulation



This insulating varnish helped shipyard electrical equipment operate under wartime overload.

G-E INSULATING VARNISH 9435

A black baking varnish ... highly flexible ... good resistance to moisture and chemicals ... recommended for manufacture and maintenance of machine tool motors

...and the same varnish can help to keep peacetime industry's electrical equipment on the job.



IN the field of insulating varnishes the General Electric label stands for 45 years of experience in research and manufacture ... large productive capacity ... expert technical service. G-E Insulating Varnishes, which were supplied in millions of gallons for the toughest war uses, now are available to all industry. You can count on uniformity of product in every shipment because of strict G-E Quality Control in every manufacturing operation. For full details consult your local General Electric Merchandise Distributor. Or write direct to Section RIMA-665, Resins and Insulation Materials Division, Chemical Department, General Electric Company, Schenectady 5, New York.



GENERAL  ELECTRIC

G. E. OFFERS A COMPLETE LINE OF INSULATING MATERIALS

NEW

ILG

DISPLAY

FOR VENTILATING FANS



SPECIAL INTRODUCTORY DEAL LIQUIDATES COST OF DISPLAY!

It sells in your window... sells on your floor! Use it as a single panel, double panel, or triple panel background display, or as a triangular island display. It gives you a complete ventilating department in less than four square feet. Sturdily constructed, colorfully finished in green, gray, and white, it is a durable, modern, attractive demonstrating unit you will be proud to feature. Best of all, you can own it on a special new *self-liquidating* deal including a selected stock of fast-selling

ILG Fans. Send coupon, or phone our nearby Branch Office (see classified directory) for details.



VITALIZED VENTILATION

AND AIR CONDITIONING



Free

Photographic portfolio showing uses of display in store, complete with outline of special deal. Get yours now.

PASTE ON PENNY POSTCARD AND MAIL TODAY!

ILG ELECTRIC VENTILATING CO., CHICAGO 41, ILL.
2879 No. Crawford Ave. Offices in 40 Principal Cities.

☐ Send portfolio with details of introductory deal.

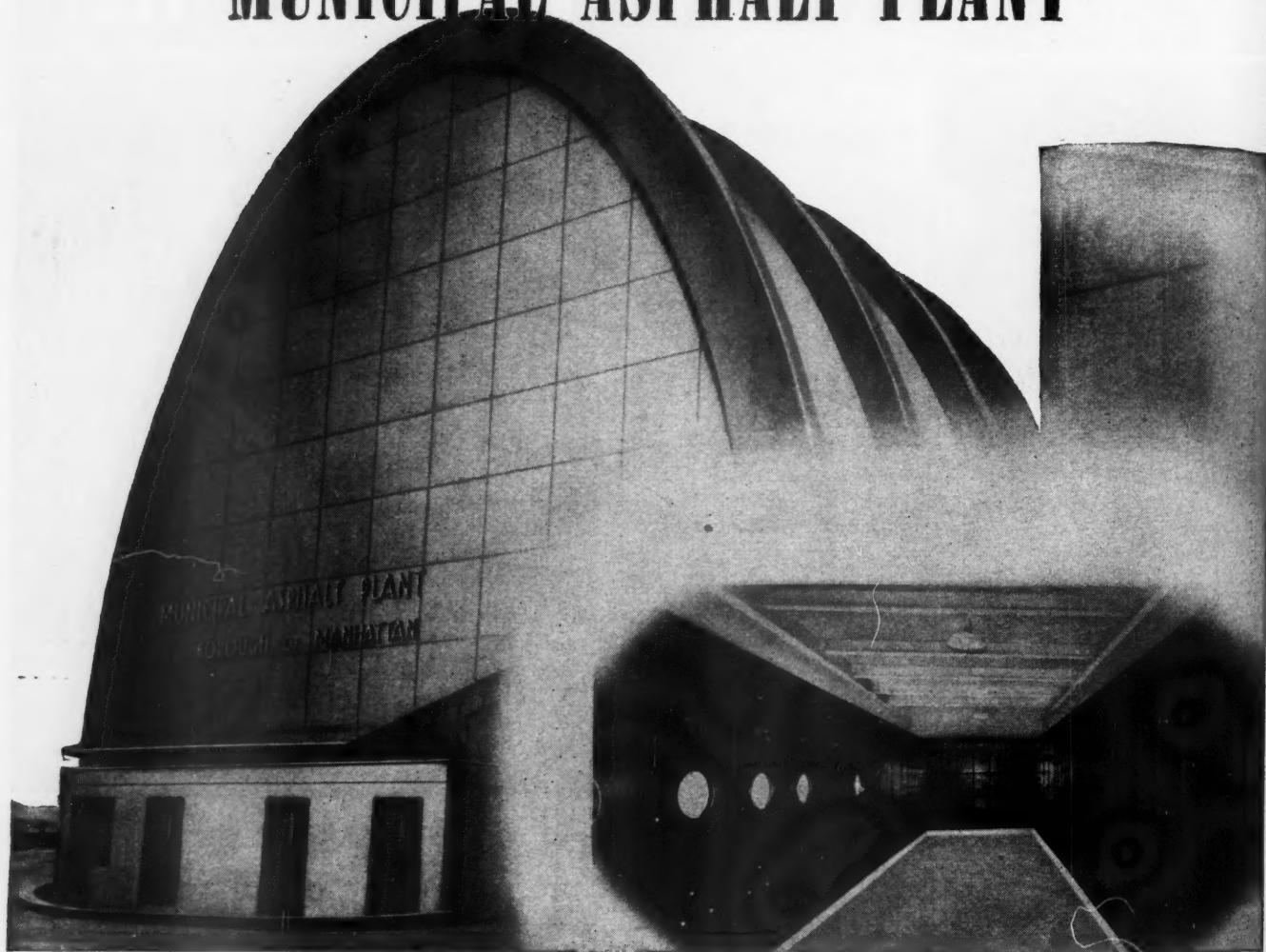
Firm Name.....

Individual.....Title.....

Street.....Zone.....

City.....

METROPOLITAN'S ELECTRICAL UNIT FOR HEATING, MOTOR AND LIGHT CONTROL IN THE MUNICIPAL ASPHALT PLANT



At the right are listed various types of electrical control equipment designed and furnished by METROPOLITAN for utilities, industrial plants, large mercantile establishments, and public buildings. Your inquiries are invited.

Knife Switchboards	Motor Control Switchboards
Circuit Breaker Switchboards	Explosion-proof Switchboards
Dead Front Switchboards	Laboratory and Test Switchboards
Battery Charging Switchboards	Control Switchboards
Generator and Distribution Switchboards	

*Complete
Electrical Control by*



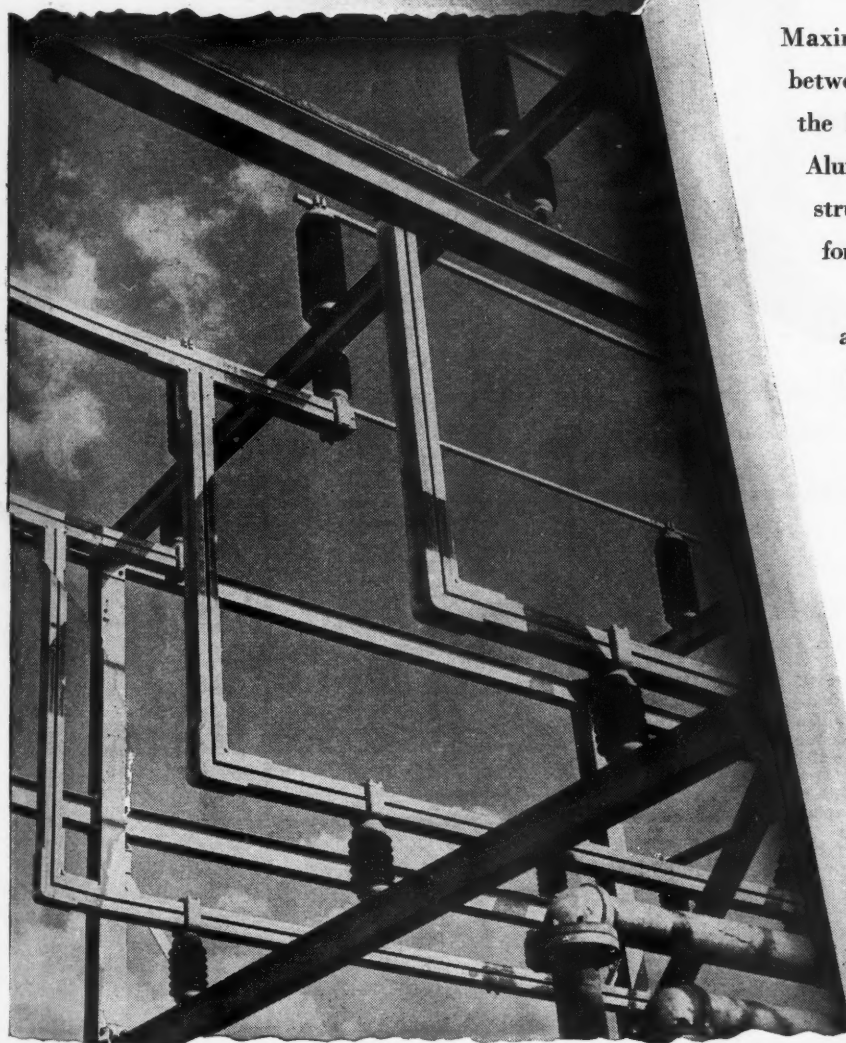
ELECTRIC MANUFACTURING COMPANY

ELECTRIC LIGHTING AND POWER

DISTRIBUTION EQUIPMENT

LONG ISLAND CITY 5, NEW YORK

*For greater resistance to
short-circuit stresses,
they placed the
Alcoa Aluminum channels
like this...*



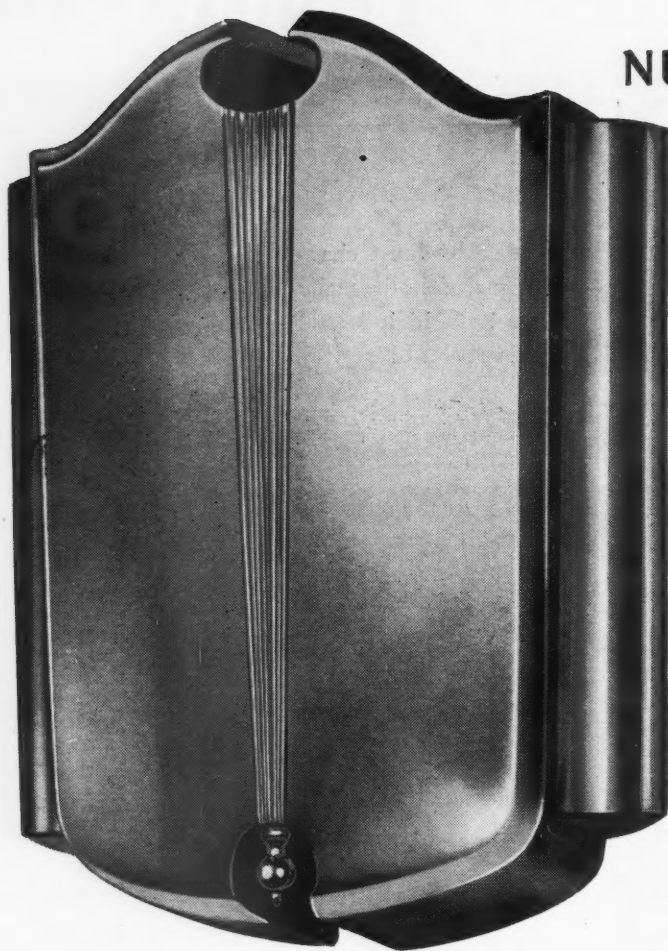
Maximum resistance to magnetic forces between phases is obtained here through the horizontal arrangement of the Alcoa Aluminum channels. The box-girder construction makes the buses rigid and, therefore, self-supporting on long spans.

Alcoa Aluminum channels, angles, flats and tubes make good-looking, efficient bus installations. High in electrical conductivity, low in weight, able to resist the elements, first costs are reasonable, upkeep low.

For quotations on Alcoa Aluminum for bus bars, fittings, housing materials and structural shapes, get in touch with the near-by Alcoa sales office. Or write ALUMINUM COMPANY OF AMERICA, 2197 Gulf Bldg., Pittsburgh 19, Pa.

ALCOA FIRST IN **ALUMINUM**





NUTONE *Jewel...*

the door chime that
makes a new home
sound like it!

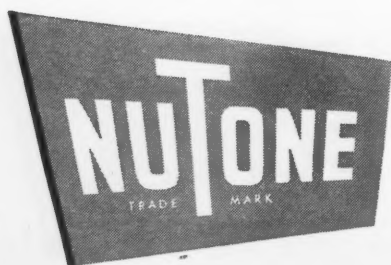
A NuTone Jewel on the wall is added proof of careful planning . . . for better living means better *listening*, too! Women will like the looks of this stunning new chime . . . they'll love its tone . . . and they'll appreciate your consideration for their comfort in recommending it.

An all-brass Colonial chime—with a touch of the modern. Sounds two tones for front door—one for rear. The NuTone Jewel, with matching push button included, lists at \$9.95.

Write, today, for details. Address your nearest NuTone office. NuTone, Incorporated, Merchandise Mart, Chicago 54; 200 Fifth Ave., New York 10; 931 E. 31st St., Los Angeles 11; or Terminal Sales Bldg., Seattle 1.



*Packed
with
Jewel
Push Button
in matching
style and
finish.*



WORLD'S LARGEST MAKER OF DOOR CHIMES



NEW POWER UNIT—self-contained, completely sealed against dust, and easy to remove while chime remains on wall.



BUILT TO LAST—test power unit has been operated 392,000 times—almost 180 years of average six-time-a-day home use!



"FRONT" PUSH BUTTON TO MATCH—identical with door chime design. All-brass plate is rustproof for outdoor mounting.



LOVELY TO LOOK AT—satin brass cover with polished, high-lighted border blends well with almost any interior decoration.

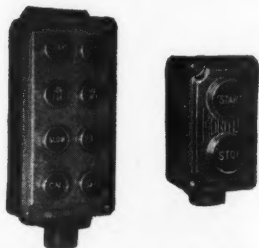


RELIABLE—made of the finest, safety-proved materials. Listed under re-examination service of Underwriters' Laboratories.

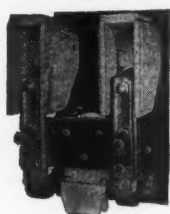


EASY TO INSTALL—a screw-driver job that's done in a jiffy if chime outlet is included in general wiring scheme.

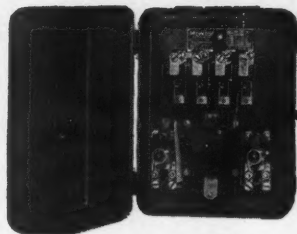
*...better living means
better listening, too!*



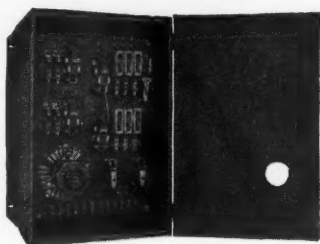
Push button control stations of all types in General Purpose and Waterproof enclosures.



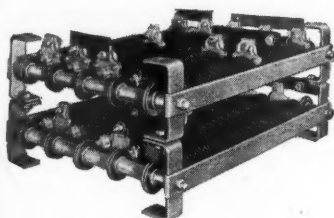
Contactors for A.C. and D.C.



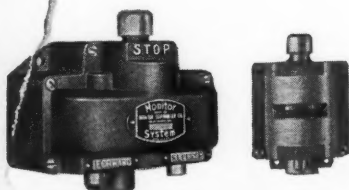
A.C. Motor Starters . . . across the line, reversing, non-reversing, and combination units.



Pre-set speed printing press controller.



Resistors . . . Edgewound, Hexwound and Smoothwound types.



Heavy Duty VB control stations built to prevent accidental starting and stopping by operators.

IN MOTOR CONTROL EQUIPMENT

our specialty is designing and building the unusual

If your motor control problem is "out-of-the-ordinary," if the job at hand requires highly specialized or unusual control arrangements, consult Monitor.

We specialize in "specialties." This means specialized controls of all types, for all purposes . . . printing presses, machine tools, pumps, laundries, ventilating fans, dairies included.

Since these specialties are built from standard units, a few of which are shown on this page, you actually get the benefits of custom-built equipment—without the additional cost.

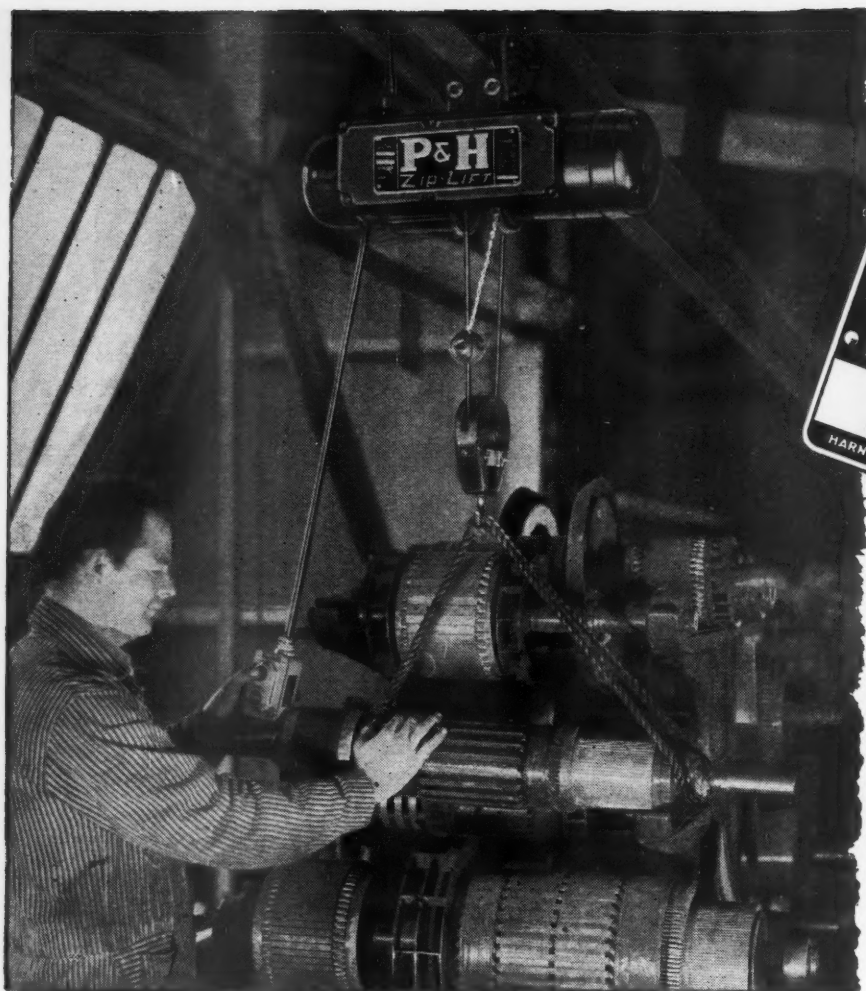
For assistance in working out your control problems on present products and new developments, see your Monitor Field Engineer. You'll find that his service is prompt, efficient, and that his specialized knowledge will save you time, money and headaches.



The Monitor Controller Company

GAY, LOMBARD & FREDERICK STS. BALTIMORE-2, MARYLAND

CANADIAN AFFILIATE • CANADIAN CONTROLLERS LTD. • TORONTO, ONTARIO, CANADA



Your smart move is "THRU-THE-AIR!"

No waste effort—no delays! Move materials "thru-the-air," and swift electric power does the work—lifting, moving, "spotting" loads—all with effortless push button control.

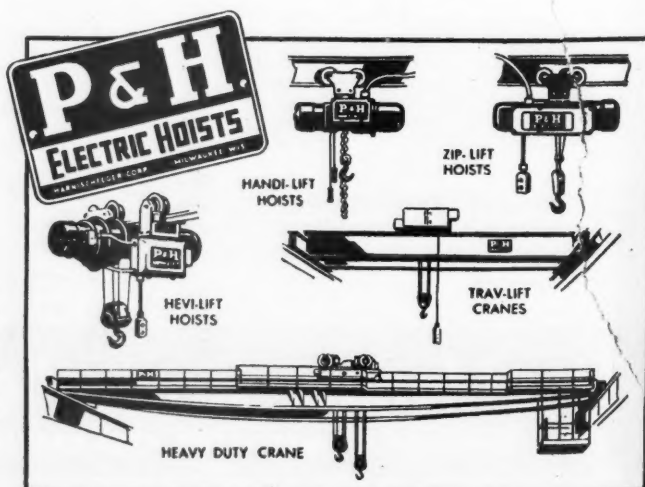
Costly? Not at all! You'll be surprised how economically P&H Zip-Lift Electric Hoists bring you all the advantages of "thru-the-air" handling. And because they cost so little to maintain . . . because they eliminate rehandling . . . because they let workers make the most of their energies . . . these modern wire-rope hoists soon repay the initial cost!

In many plants today, hook-, jib-, and trolley-mounted Zip-Lifts are handling materials all the way from raw to finished state. Have you considered similar savings for your plant? It's a smart move to talk it over with a P&H Hoist Engineer . . . or write for free Zip-Lift Bulletin!



4426 West National Avenue

Milwaukee 14, Wisconsin






Plugin



plugin

UNITS

All  Plugin Units, attractively finished in pearl grey enamel, are ready to plug into any one of the standard outlets of  Busduct... and can be mounted on either or both sides of the Busduct section. Their sturdy galvanized sheet steel enclosures and their rugged compression-type bus bar connectors add to the life and service of your  Busduct electrical system.

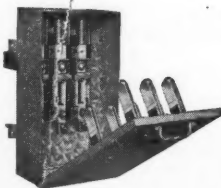
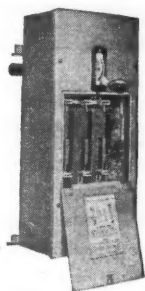


CIRCUIT BREAKER

This Plugin Unit provides automatic thermal protection for circuits and equipment. Capacities: 15-225 amps., 250 and 575 volts.

SHUTLBRK

A quick make-and-break, heavy-duty operating switch... excellent for frequent operation. Capacities: 30-200 amps., 250 and 575 volts.



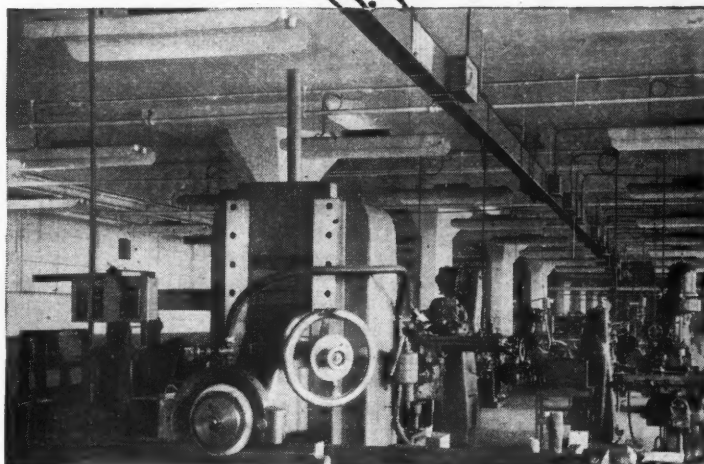
KLAMP SWITCHFUZ


Excellent for disconnect service... the hinged-type pull out door contains *both* switch and fuse in one unit. Capacities: 30-200 amps., 250 and 575 volts.


BUSDUCT



for POWER DISTRIBUTION

"All Along the Line"



If you are looking for an efficient yet economical way to increase the productive capacity of your plant, then consider  BUSDUCT—the modern method of power and light distribution.

Combining high efficiency with greatly increased flexibility and economy,  PLUGIN BUSDUCT makes power available *where* and *when* you need it. It reduces to a minimum the costly delays of moving and relocating machinery, and eliminates long expensive lead-ins with a consequent fluctuation in voltage.

 PLUGIN BUSDUCT provides all the capacity needed for large and small machinery. Made in standard 10-foot sections with multiple outlets for either Circuit Breaker, Shutlbrak or Klampswitchfuz Plugin Units,  PLUGIN BUSDUCT is easy to install and economical to operate. Designed for 2, 3 and 4 wire systems, 250-1000 amp. capacities for 575 volts AC or less.

For full details consult your nearest  representative.

Frank Adam Electric Co.

ST. LOUIS, MISSOURI

FUSETRONS

-Prevent Needless Shutdowns,

Here's Why

Fusetrons have a tremendous time-lag—far greater than ordinary fuses—due to the combining of a fuse and a thermal cutout.

Here's how time-lag of Fusetrons compares with that of ordinary fuses.

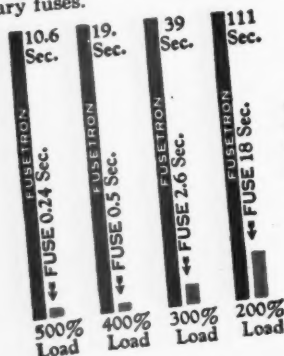
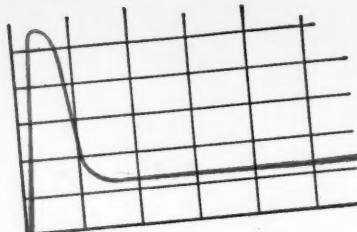


Chart shows 30 amp. 250 volt fuses. Other sizes and 600 volt ratings show similar results.

The great time-lag of Fusetrons permits them to hold harmless overloads and keep circuits in operation instead of opening and causing useless shutdowns.

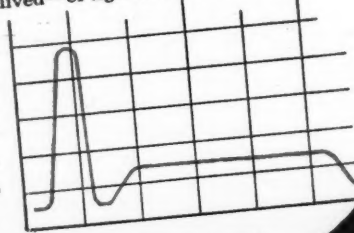
Ordinary fuses or other forms of protective devices cannot do this job.

AC motors require a current of 3 to 9 times their rating for starting. This high starting current often causes ordinary fuses to open.



Fusetrons Have the Capacity to Absorb This High Starting Current Without Opening—even where type of load causes starting current to hang on.

In normal operation overloads often occur that are heavy but short lived—or light overloads hang on. In either instance they are harmless—yet they often cause ordinary fuses or other forms of protective devices to open.



Fusetrons Will Hold Such Harmless Overloads—and Keep the Circuit in Operation.

FOR EXAMPLE

LIKewise

• • INSTALL FUSETRONS THROUGHOUT THE PLANT TO GET

- ★ Entirely wipe out needless blows caused by motor starting currents or other harmless overloads.
(See above)

- ★ Give Thermal Protection to Panelboards and Switches
The thermal cutout in the Fusetron will open whenever its temperature reaches 280° F. Thus if poor contact heat develops from any cause the Fusetron cuts off the current before damaging temperatures can be reached.
Ordinary fuses can't so protect because the temperature of the link must reach 786° F. before it will melt out.
With Fusetrons you are warned that a minor maintenance job is needed instead of having panel or switch damaged or destroyed by poor contact.

- ★ Prevent Needless Blows Caused by Heating in Panels and Switches
Ordinary fuses have 55 to 140% greater electrical resistance at full load than Fusetrons, hence Fusetrons produce less heat and thus eliminate useless shutdown troubles caused by fuses running too hot in panelboards and switches.

- ★ Permit Use of Larger Motor or Adding More Motors on Circuit WITHOUT Installing Larger Switch or Panel
The operating load on Fusetrons can be close to their ampere rating because Fusetrons hold starting currents. But ordinary fuses

must be installed oversize because they lack sufficient time-lag to hold starting currents.

By replacing oversize fuses with Fusetrons, you can load panels or switches to near capacity. A large motor or additional motors can be installed without the trouble or expense of changing the panel or switch.

- ★ On New Installations PROPER Size Switches and Panels Can Be Used Instead of OVERSIZE

With ordinary fuses, switches and panels must be oversize because fuses larger than the operating load must be used to hold starting currents.

But Fusetrons hold starting currents, therefore, PROPER size switches and panels to fit the load can be installed, saving money and space.

- ★ Protect motors against burnout

On normal installations, Fusetrons used in a size near ampere rating of motor will protect it against burnout from lack of oil, worn bearings, tight belt or anything that causes a dangerous electrical overload—yet their tremendous time-lag keeps them from blowing on motor-starting current.

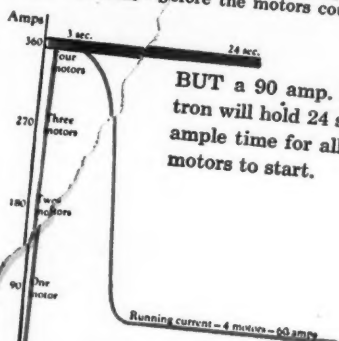


BUSS

Hold Harmless Overloads without Sacrificing Protection

This tremendous time-lag will also prevent needless blows on MAINS AND FEEDER CIRCUITS. Even if all motors on the circuit start at one time—Fusetrons will not open. For example: four 15 ampere motors on a circuit would ordinarily be protected by 90 ampere fuses.

If these four motors start at one time and the starting current of each motor is 90 amperes, the combined starting current is 360 amperes. At this load a 90 ampere fuse would open in about 3 seconds—before the motors could start



BUT a 90 amp. Fuse-tron will hold 24 sec.—ample time for all four motors to start.

SO with Fusetrons installed in mains, feeders and all branch circuits—shutdowns caused by the needless opening of fuses or other forms of protective devices on motor starting currents or other harmless overloads are entirely wiped out.

HERE'S PROOF

"Fusetrons Saved Us a Lot of Money and Trouble on Our Crusher Circuit"—Paul G. Nunn, Manager, The Nunn Company, Overton, Nevada.

Mr. Nunn continues, "In April, 1942, we installed a crusher powered by a 40 h. p. motor. Ordinary fuses were installed. We had trouble from the beginning as the fuses would blow out almost as fast as we could put them in. We were advised that the motor was too small and it was recommended that a 60 h. p. motor be installed. The cost of the new motor and larger feeders we were told would amount to about \$2,000.00.

"We were about to go ahead, however, as the shutdowns were costing us about \$20.00 per day in labor alone not to speak of loss in production.

"My brother, however, sent us a set of Fusetrons and suggested we try them out. We did. Much to my surprise when the power was thrown on the Fusetrons held. This was nearly two years ago and we have not had a Fusetron blow.

"I feel that you should know that Fusetrons saved us a lot of money and a lot of trouble. We are changing over to Fusetrons throughout our plant."

MANY KINDS OF PROTECTION HERETOFORE NOT AVAILABLE

★ Give DOUBLE burnout protection to large motors

Larger motors already equipped with overload protection sometimes burn out due to thermals or relays failing to operate. Replace fuses used for short-circuit protection with Fusetrons of size near motor rating and they will protect motor against burnout from any electrical overload, entirely independent of other overload device.

★ Provide simplest way to stop burnouts from single phasing

When single phasing occurs, increased current flowing through remaining phase will open Fusetrons (if size used is near the rating of the motor) and shut down motor. Never before has such dependable single phasing protection been available.

★ Make burnout protection of SMALL motors simple and inexpensive

Small motors have generally been operated without burnout protection because the cost of protecting them has been too great compared to cost of replacing motor. Now for the little cost of

installing a Fusetron of proper size, any motor can be given safe, dependable burnout protection.

★ Protect Coils, Transformers and Solenoids against burnout

Install a proper size Fusetron. It won't open on harmless overloads or normal current surges, yet should a dangerous overload occur for any reason it will cut off the current to prevent a burnout.

Get All the Facts

★ GET BETTER PROTECTION—SEND THE COUPON NOW

Even one lost motor or one needless shutdown or one destroyed panel may cost you more than replacing every fuse with a Fusetron. Don't risk such losses, change over the whole plant to Fusetrons.

BUSSMANN MFG. CO., University at Jefferson • St. Louis 7, Mo.

Division McGraw Electric Co.

FUSETRONS

SOLD THROUGH WHOLESALE

BUSSMANN MFG. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)
Please send me complete facts about BUSS Fusetrons.

Name _____

Title _____

Company _____

Address _____

City _____

State _____

FC-646



INSTA-START Makes Fluorescent Lighting Really Modern and Efficient

Fluorescent lighting without INSTA-START is like motion pictures without color — good but not the best. INSTA-START provides built-in, and therefore permanent, instant starting and stabilized performance. It does away with separate starters and starter failures and is the complete and final remedy for fluorescent's skeleton-in-the-closet, *Excessive Maintenance*.

For several years INSTA-START production was limited to two models, designed for major industrial and commercial installations. As soon as electrical steel and copper wire are in larger supply other INSTA-START models will make instant starting available for a wider range of fixtures, lamp combinations and lighting purposes such as residential and office lighting, show cases and store fixtures, etc.



Write for latest circular on INSTA-START Transformer

THE FRANCE MANUFACTURING COMPANY

Manufacturers of INSTA-START Fluorescent Transformers and Franceformers for Neon Signs

10325 BEREA ROAD • CLEVELAND 2, OHIO

In Canada: Allison Armature Works Inc., 21 McCall St. Toronto

SERVICE with a SMILE
and all the tools

— ONLY American MAKES THIS STOREROOM ON WHEELS

American designs line construction bodies for one purpose—to help utilities maintain service at low cost per mile.

The list of materials transported conveniently and safely in an American DPL or DT Line Construction Body includes ladders, pike poles, derricks, and the dozens of other articles needed on the job. Full equipment means better service at less cost to you.

American incorporates these many diversified items in a rolling storehouse by scientific ratio of weight, strength, and durability. To make all this possible, we need:

- (A) good body engineers — American has them.
- (B) ample facilities — American has full assortment of tools and a large plant.
- (C) experience — American has been in the business for 30-odd years.
- (D) customer confidence — American and American's utilities co-operate in designing equipment.

American makes six basic lengths—and offers 60 optional equipment items.

Maintain your high service standards with American (we carry everything) Line Construction Bodies.

LOG OF AN AMERICAN ROLLING STOREHOUSE

- 1 Flat-top Wheel Housings
- 2 Platform extension—non-skid steel plate
- 3 Roomy Compartments
- 4 Pressed-in Combination Rubrail and Drip Mouldings
- 5 Weatherproof Roof Enclosure
- 6 Adjustable Ladder Racks
- 7 Derrick Tunnel
- 8 Digging Tool Compartment
- 9 Full Length Inside Compartments
- 10 Swivel-type Material Hooks
- 11 Thru Boxes
- 12 Pintle Hook
- 13 Extended Sheave Bar Brackets.

Just off the Press!

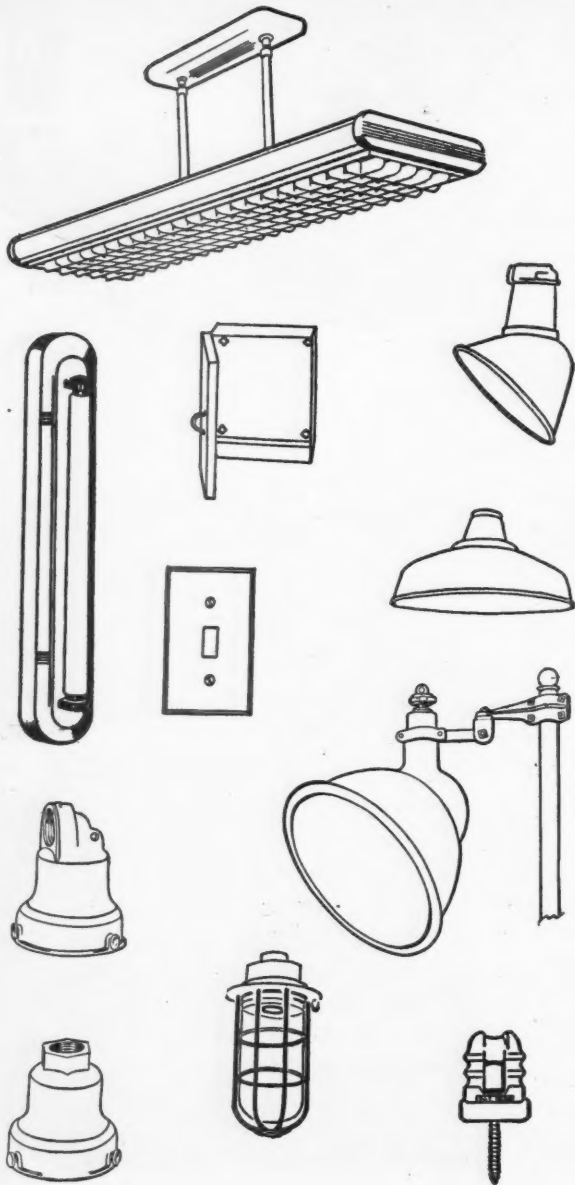
New bulletin on American's Line Construction bodies shows dimensions, sizes, equipment, features, and other information of interest to you. Your copy ready to mail upon request.

THE American COACH and BODY COMPANY
9503 WOODLAND AVE., CLEVELAND 4, OHIO

"Baker American" . Baker Equipment Engineering Co., Richmond, Va. . Sales and Assembly



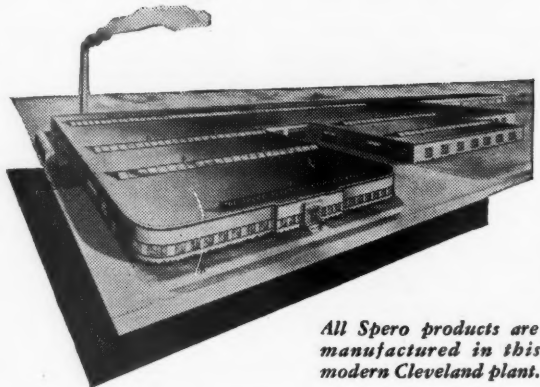
SPERO



Reconversion at The Spero Plant is now completed, and full-scale production of our regular peacetime lines has been resumed.

Spero Products are distributed only through verified wholesalers.

...5 LINES
of Products from
one dependable source



All Spero products are
manufactured in this
modern Cleveland plant.

Fluorescent Luminaires

for commercial, industrial and residential installation. Of special interest is the new Spero MSB (minimum surface brightness) glass-shielded line, bringing new architectural beauty to decorative lighting.

Reflectors

Shallow and dome type, one-piece seamless construction—keyless and pull chain styles. Wide variety of types and sizes for 75 to 750 W lamps.

Floodlights

Open types and outdoor weatherproof types fitted with prismatic lens. Finished in "Duralum". Sizes for lamps from 150 to 1500 W. Also Yard Lights and Cargo Lights.

Vaporproof Units

Pendant or bracket types—available for 3" and 4" outlet box mounting, also "X" types. With or without wire guard. Reflectors available. Lamp sizes 50 to 300 W.

Construction Equipment

Outlet boxes, Switch Plates, Zinc Diecast Sockets, Porcelain Wire-holders (lag or machine screw type) and Multiple-Point House Brackets. Made of quality materials to Spero's high design standards.

Write for complete information



THE SPERO ELECTRIC CORPORATION
18222 LANKEN AVE. ★ CLEVELAND, OHIO



Built to encourage continuous electrical change

Electrical change calls for an electrician.

Q-Floors call for electrical change. They are designed and sold on the idea that floors should be completely electrically available and that electricity should be used to the full. This year. Next year. As long as electricity is used.

Any building constructed with Q-Floors, is sold, rented and tenanted with the understanding that tenants may and will keep their floor layouts up-to-date electrically.

Q-Floors promote the use of more and more electricity.

H. H. ROBERTSON COMPANY

2400 Farmers
Bank Building,
Pittsburgh 22,
Pennsylvania

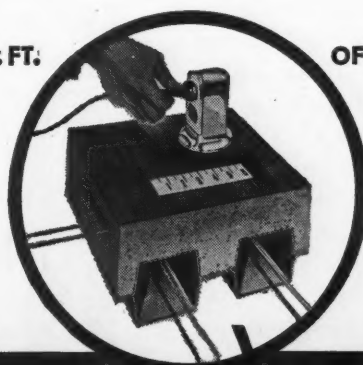


Offices in 50
Principal Cities
World-Wide
Building Service



Electrical fittings for use with Robertson Q-Floors can be obtained from General Electric Construction Materials distributors. See the nearest G.E. merchandise distributor for information on how Q-Floor fittings can be used to attain up-to-the-minute electrical wiring.

THIS IS 1 SQ. FT.



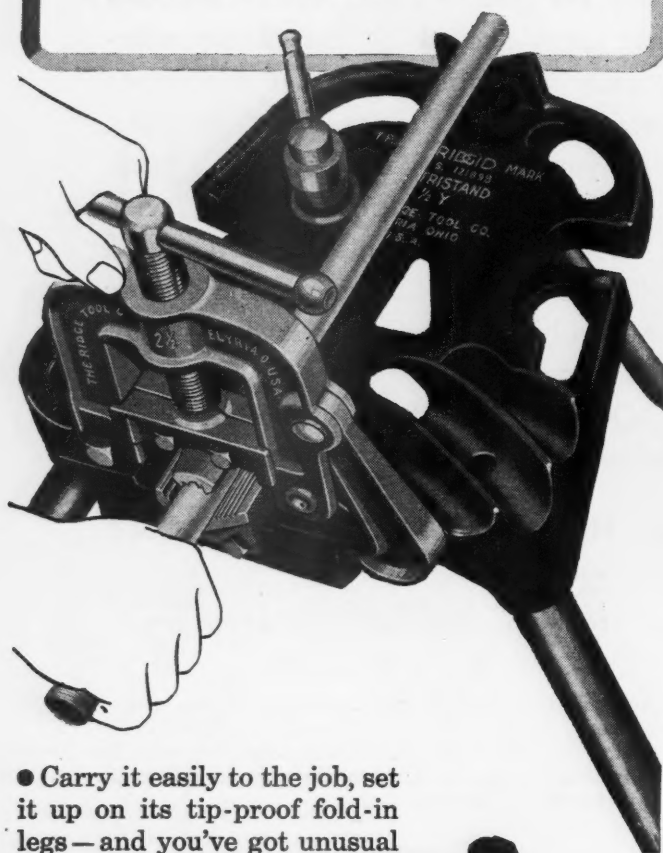
OF Q-FLOOR

Q-FLOORS

RIGGID

TRISTAND

**gives you a smart
vise and handy work-
bench all in one...**



● Carry it easily to the job, set it up on its tip-proof fold-in legs — and you've got unusual working convenience. Roomy tray for dope pot, oil can, handy slots for tools, a pipe rest to make cutting or threading easier, 3 benders that won't dent pipe — and either yoke or chain vise with LonGrip jaws that hold pipe firmly without scratching. More for your money; ask your Supply House for **RIGGID** Tristands.



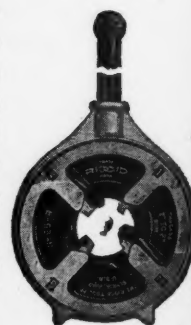
**You cut perfect 1" to
2" pipe threads with
least effort with
Precision-built, Self-contained**

RIGGID

No. 65 R



● If you've never used this remarkable steel-and-malleable No. 65R die stock, you have a pleasant surprise coming. Workholder sets to pipe size instantly, no bushings to fool with — dies adjust to 1," 1¼," 1½" or 2" pipe in 10 seconds! With least possible effort the high-speed steel chasers cut smooth perfect threads on any pipe. It's precision quality in every part. For performance and long life... for surprisingly easy threading... buy the **RIGGID** 65R at your Supply House.



RIGGID No. 65R
stands up hand-
ily on the floor.

Millions of **RIGGID**
Tools in use

RIGGID

WORK-SAVER PIPE TOOLS

The Ridge Tool Company
Elyria, Ohio, U. S. A.

BURNDY

Scrulugs



**NOW AVAILABLE IN
SIZES UP TO 500 MCM**

BURNDY ENGINEERING CO., INC., 107-DBRUCKNER BLVD., N. Y. 54, N. Y.

To help increase "Take-Home Savings"

THE Treasury Department has published two new booklets to help you and your employees realize the utmost benefit from your Payroll Savings Plan—benefits proportioned to the extent your employees add to "take home savings" by buying and holding U. S. Savings Bonds.

"Peacetime Payroll Savings Plan" for key executives offers helpful suggestions on the conduct of the Payroll Savings Plan. In addition, it quotes leaders of Industry and Labor and their reasons for supporting the Plan.

"This Time It's For You" is for distribution to employees. It explains graphically how this convenient, easy thrift habit works. It suggests goals to save for and how much to set aside regularly in order to attain their objectives. If you have not received these two booklets, or desire additional quantities, communicate with your State Director of the Treasury Department's Savings Bond Division.

See your Payroll Savings Plan through to maintain your share in America's future. It is sound economics and a powerful force for good today—and tomorrow—as a safeguard for stability and a reserve of future purchasing power—money that is kept within your community.



The Treasury Department acknowledges with appreciation the publication of this message by

ELECTRICAL CONTRACTING

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and Advertising Council

Chelsea Ventilating Coolers for Home, Office, Factory or Store!



PLAN NOW

The demand for modern ventilation will provide "tops" in residential construction. Chelsea Ventilating Coolers afford quiet, efficient ventilation with maximum air volume. This is backed by the experience of Chelsea blower engineers for most in



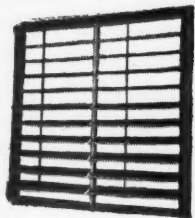
TYPE IND STREAMLINED INDUSTRIAL FAN:



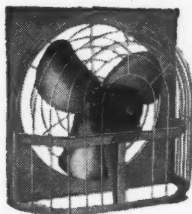
TYPE ED STREAMLINED ATTIC FAN:

rolled-steel blades under static pressure. Totally enclosed ball-bearing motor. Moving parts are rubber cushioned.

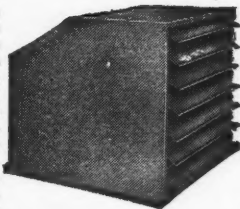
INVESTIGATE THESE WIDELY-USED CHELSEA VENTILATING UNITS



Type LWL Automatic Louvers: For general ventilation installations. Protects fan when not in use. Aluminum leaves pivoted in machined brass to reduce friction; tie rods cadmium plated bushings. Larger units dual to eliminate twisting of leaves.



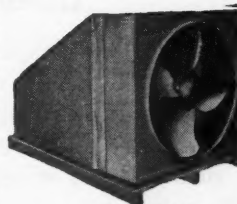
Type AA Utility Fan: For cold storage, meat packer and freezer applications. Totally enclosed ball bearing motor with both front and rear guards. Capacity: AA20—3000 CFM; type AA24—4800 CFM. Fan speed—1100 rpm.



Type PH Penthouse Roof Ventilator: For roof ventilation. Operates against static pressures using the IND type industrial fan housed in steel penthouse with automatic shutters. Completely assembled—ready for installation.



Type P and MC Pedestal Fans: For shops, offices, stores, and factories. Rugged construction with steel die-stamped blades. Motor and fan shaft ball bearings. All parts protected against rust. Available in a wide range of sizes.



Type EU Package Attic Fan Unit: For cooling homes, churches, hotels, hospitals, schools, etc. New streamlined venturi orifice delivers greater air volume. ASH and VE method certified ratings. Efficient, low current consumption motors.

CHELSEA

CHELSEA PRODUCTS

1206 GROVE STREET, IRVINGTON, NEW JERSEY

Congress has acted—and along these lines—since this editorial was written. If the President signs the legislation, we have taken one step forward. If he vetoes it, the voters must resolve a conflict between two branches of their government.

THE LABOR CRISIS

—it's up to Congress

IT HAS remained for John L. Lewis to demonstrate conclusively that, under the sponsorship of the federal government, the power of organized labor has been built up to a point where it can be used to paralyze the economic life of the nation. Therefore, in the elemental interest of self-preservation, the first order of the day is to cut down the power of organized labor to a point where irresponsible leaders no longer have the power to use it to cut down the country.

This will prove an exceedingly complicated job. The federal government, over a dozen years, has developed and buttressed the power of organized labor by many separate steps. They are interlaced in a pattern which cannot easily be unravelled.

Cutting down the power of organized labor to proper proportions will be an operation almost as delicate as brain surgery. To be successful it must impair no basic American political or economic right. It must leave intact the right of workers to organize and bargain collectively through representatives of their own choosing. It must leave intact the right to strike. But it must disassociate from the exercise of these rights opportunities for devastating abuse of the public welfare such as those demonstrated by Mr. Lewis. A meat axe is not the instrument for this operation.

Because of the complexity and delicacy of the operation to be performed it would be helpful if it could be carried out in a tranquil atmosphere. The urgency of the problem is such, however, that no time can be lost in getting at it.

Guiding Principles

However, the dangers that haste or heat will lead to serious blunders can be largely eliminated if the process of bringing the power of organized labor back within safe and reasonable bounds is governed by principles to which all fair minded people can fully subscribe.

The most important of these principles is that it is an abuse of public authority to extend special privileges to organized labor.

When in 1935 Congress passed the Wagner Labor Relations Act, one of the great buttresses of the power of organized labor, it was upon the explicit theory that organized labor was weak and needed coddling by the federal government if it were to survive, let alone grow big and strong. In the policy

section of that act it was stated that "the inequality of bargaining power between employees who do not possess full freedom of association or actual liberty of contract, and employers who are organized in the corporate or other forms of ownership association substantially burdens and affects the flow of commerce . . ."

Regardless of whether or not that was a correct reflection of the situation in 1935, it bears no relation to the situation today. Under the continuous sponsorship of the federal government, the power and bulk of organized labor has waxed until today it is preposterous to regard it as the weak sister in its bargaining with employers. If, after being continuously demonstrated since V-J Day, the proposition that the pendulum of organized power has swung too far over on the side of organized labor needed any final and clinching demonstration, John L. Lewis provided it.

Changes in the Law

Translation of the principle that organized labor is no longer a weakling, requiring a diet of special privileges, into specific legislative enactments is a detailed technical operation beyond the scope of this statement. It is possible, however, to indicate some of the general lines it should follow. Here they are:

1. The duty to bargain collectively, now imposed upon employers by the Wagner Act, should also be imposed upon the leaders of organized labor who are now under no legal compulsion to bargain.

For well over a month Mr. Lewis made a complete mockery of the process of collective bargaining by refusing even to state his demands until the coal operators had approved "in principle" a plan for a miners' "health and welfare" fund which he fancied. In the meantime the country was plunged into an ever deepening crisis.

2. Unions, as well as employers, should be made liable to suit for damages for breaking their collective bargaining agreements.

A degree of responsibility commensurate with their age and power requires that unions be liable, to the extent of union funds but not the funds of individual members, for carrying out their agreements. To have it otherwise is to hold that a collective bargaining agreement is, by defi-

nition, a phoney agreement so far as the union is concerned. Outlaw strikes are the fruit of this lop-sided arrangement.

3. Employers should be given more discretion, in reinstating employees who have gone on strike than is now permitted by the Wagner Act.

The Wagner Act largely eliminates the risks involved in striking because of the requirements it imposes upon employers to take workers back when they have decided to return to work. These requirements make it virtually impossible for the employer to replace workers even if they are engaged in the most unjustifiable of strikes. At the least workers who have smashed up property and stirred up violence in the course of a strike should have no rights under the Wagner Act. How much further the Wagner Act strait-jacket should be loosened at this point should be carefully explored, and excesses encouraged by the Act should be removed.

4. The wedge which the National Labor Relations Board has driven into the orderly conduct of American industry by holding that foremen are covered by the Wagner Act should be eliminated.

The issue involved here is continuously mislabelled and confused as that of the right of foremen to organize. There is no question of the right of foremen to organize any kind of a legal organization they desire. That is their right as American citizens. The issue is whether or not the special privileges accorded by the Wagner Act, which in some circumstances has been so construed as even to prevent employers from talking with their workers, should be extended to foremen who, if American industry is to have a chance to do its duty effectively, must represent management with full loyalty and responsibility.

A member of John L. Lewis' United Mine Workers takes an oath which provides, in part, "that I will not reveal to any employer or boss the name of anyone a member of our union" and will "defend on all occasions and to the extent of my ability the members of our organization." Mr. Lewis insists that the coal operators contract to deal with foremen to be organized in a union where they will take that oath, and where their activities will be separated from the influence of employers by the barriers imposed by the Wagner Act. Such an arrangement undercuts orderly management of American industry.

5. The exemption of labor unions from the federal anti-trust laws, provided when organized labor was presumed to be weak, should be modified to take account of its vastly increased strength, and

the use of this strength to destroy business enterprise and create monopoly.

As matters stand unions can run employers completely out of business by secondary boycotts and run fellow workers out of jobs in the process. An Ohio manufacturer, working with a government-certified C. I. O. union, is put out of business because A. F. of L. workers refuse to handle his products. Still the government, this time in the person of the United States Supreme Court, says that actions of this sort are above the law because Congress exempted unions from the federal anti-trust laws.


To eliminate one of the most devastating forms of restraint of trade, this exemption should be cut down forthwith by subjecting unions imposing secondary boycotts to the same penalties under the federal anti-trust laws as those to which employers doing the same thing are subjected. And the question of further narrowing the obsolete exemption of unions from the federal anti-trust laws should be fully explored.

6. The levying of special sales taxes for the exclusive benefit of unions should be prohibited by law.

As a matter of good government the right to levy consumption taxes should be reserved to the public authorities and used strictly for public purposes. As a matter of good economics, payments to workers or their organizations should be included in the payroll where they can be properly counted as part of the cost of production.

Equality Before the Law

When everything that can conceivably be accomplished by legislation has been accomplished there is no reason to believe that an ideal or even a surely workable system of industrial relations will have been devised. Many of the mainsprings of such a system lie deep in the hearts of men and far beyond the reach of legislation. There is no chance, however, of having such a system, or even a defensible system of democratic government until special privileges which tip the scales of power far on the side of organized labor are withdrawn and there is some measure of equality for employers and organized labor before the law. Though it is hard to believe it at the moment the country may come to be grateful to John L. Lewis for driving that lesson home so ruthlessly.



President, McGraw-Hill Publishing Company, Inc.



Mercury Lamps with Jefferson Transformers installed in warehouse

Where Lighting Requirements Dictate Mercury Lamps . . . It Pays to be Choosy in Selecting the Transformers



Write for
Bulletin 421-ML

Lower power consumption, uniformity of intensity, and suitability to specific requirements have resulted in a constantly increasing use of mercury lamps.

Like other gaseous discharge luminaries, these lamps require closely coordinated Transformers to govern the current through the starting period and operating cycle since a great change in internal resistance takes place.

Correctness of design of Jefferson Transformers has been amply demonstrated in factories, mills, warehouses, gymnasiums in all parts of the country. Quality control of all steps of Transformer manufacture under our own roof, together with facilities and resources un-

surpassed insure long trouble-free service.

Jefferson Electric Mercury Lamp Transformers have been tested and approved by Electrical Testing Laboratories of New York, and they are listed by Underwriters' Laboratories, Inc. and carry the Underwriters' Re-examination Service Labels.

Bulletin 421-ML will give you the data you need for single and two-lamp transformers, normal and high power factory types and capacities. Let us mail you a copy. **JEFFERSON ELECTRIC COMPANY**, Bellwood (Chicago Suburb), Illinois. *In Canada:* Canadian Jefferson Electric Co., Ltd., 384 Pape Ave., Toronto, Ont.



MERCURY LAMP TRANSFORMERS

Electrical Contracting, June 1946

JUNE at a Glance

Better Methods

New York's \$6000 prize contest for electricians who submit ideas for power tools and job methods to speed housing is worth watching. It's an earnest effort already showing results. Some cynicism has been evident in private comments on the plan, but from here it looks good. Local 3's participation is enthusiastic and entirely understandable when you consider the problem ahead. One aspect, a housing boom is in the making that will take a lot of mechanics. The fewer permit men and floaters needed to do the job, the fewer headaches for the union. We hope the contest will be thoroughly successful. We hope the rest of the construction industry will follow the New York Joint Industry Board's far-sighted lead.

Instant Hot Water

It has always seemed anachronistic to us to see electric water heaters with large storage tanks hooked up to hot water pipes. We turn kw's into B.t.u.'s, store the heat in 30 gallons or so of water, then carry it 30 or 40 feet through pipes. Some of our best friends are plumbers, but we would rather see kw's carried around in wires than B.t.u.'s in pipes; besides it's a lot more efficient. There's only three places in the home where we want hot water; bath, kitchen and laundry. That would mean three or four instant water heaters as against one storage type heater and a hot water piping system. There's an opportunity here for some revolutionary changes with wiring very much on the plus side. Let's have your comments.

Winding Costs

While horsepower and speed are vital characteristics for application of motors, other factors provide more accurate measures for shop work, rewinding estimates and shop production controls. George P. Svendsen of Boustead Electric and Manufacturing Company in Minneapolis, introduced a classification system several years ago based upon physical dimensions. In this issue he discusses winding and connecting time based upon a long study of shop production analysis. See "Winding and Connecting Time", page 73.

Class I, Group D

Few applications of wiring require such specialized materials and installation as those in the petroleum industry. G. A. Hausske's article, "Wiring for the Petroleum Industry", beginning on page 59 is an experienced analysis of some of the special problems with practical solutions from the standpoint of both installation and maintenance. If you have wiring jobs ahead in a "cat cracker" or the corner gas station, you'll find useful data here.

Color

Time was when a pattern of fixtures was all that mattered in lighting. Nowadays, with engineering emphasis on the lighting results there are a lot of factors we have to think about beyond the light source and its wiring. Color is one. For instance, fluorescent lighting offers several shades of "white"

light. Charles L. Amick of Nela Park, author of authoritative books and papers about lighting, discusses the role of color in lighting as a part of our series on lighting techniques. It begins on page 66.

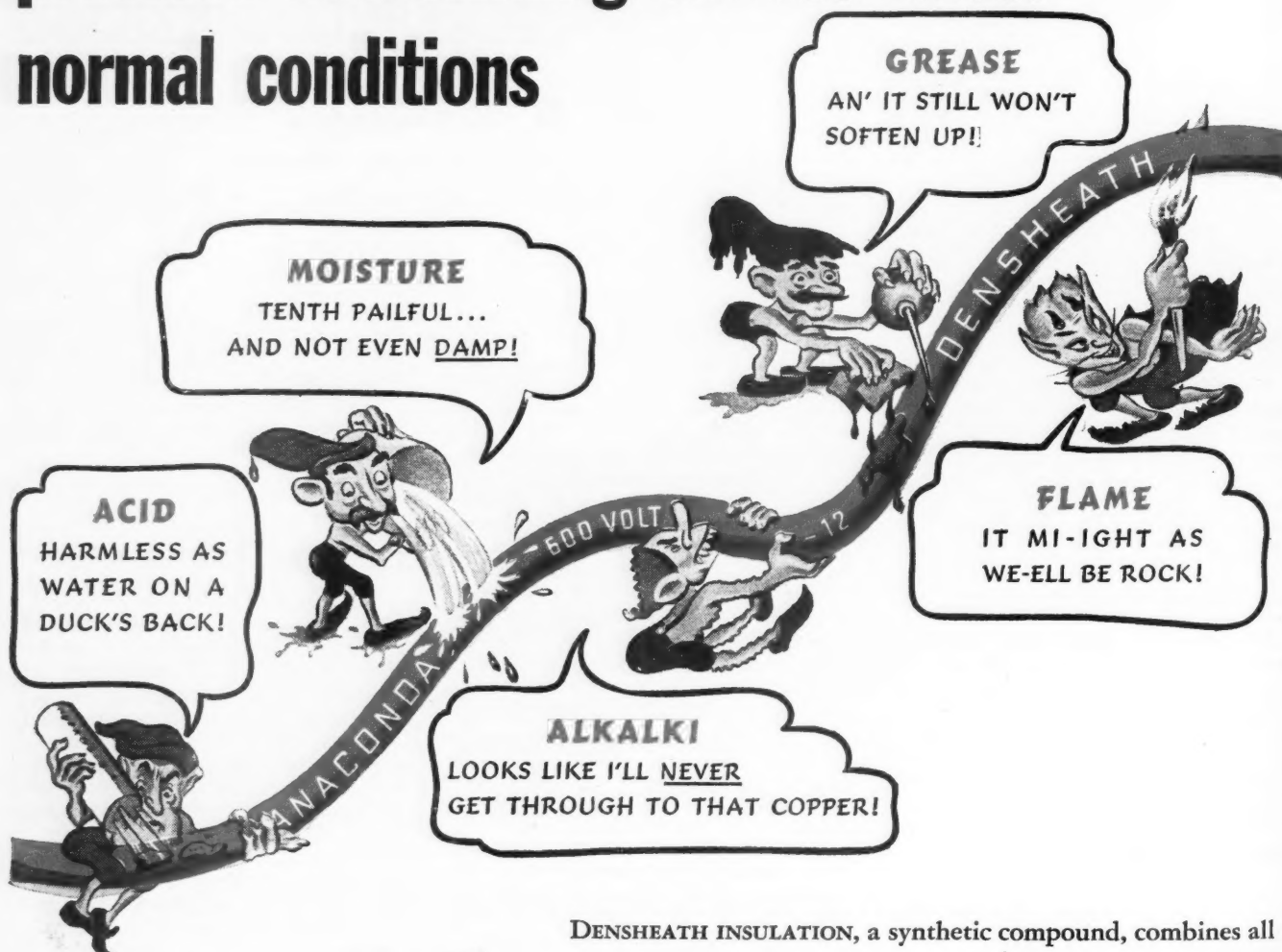
Service Data

We know it's good sales talk for manufacturers of industrial electronic apparatus to emphasize the trouble-free character of the equipment and the convenience of factory service, but electrical maintenance men still have to live with it. They want the manufacturers to give them more and better information on the care and maintenance of particular assemblies. Little things can and do go wrong, and factory service or not, the electrical department is going to try to keep the apparatus in operation. There has been a lot of emphasis on education in electronics for industrial electrical men and we're all for it. But good plain language service and maintenance data is just as important.

Contract Maintenance

Lighting maintenance is good business. It is a badly needed service in stores and offices and as lighting systems grow more elaborate the need will be greater still. Some contractors have tried it out, found it profitable and a good business builder. Watch for B. C. Cooper's article next month on The Jack Stone Company's experience on lighting maintenance contracts in Washington area commercials.

Developed to withstand severest hazards...
provides outstanding service under
normal conditions



TYPE TW
Approved by Under-
writers' Laboratory
FOR USE IN OIL
*Type T† for dry locations.
Type TW† for moist locations.
†New designations for Types
SN & SNW.



DENSHEATH INSULATION, a synthetic compound, combines all of the advantages illustrated . . . and is superior to rubber compounds in many other ways: Durable • Smooth, polished finish • Pliant • Excellent super-aging qualities • Superior dielectric strength • Good resistance to abrasion, tearing, bending, flexing • Can be used anywhere Type R is allowed • Densheath provides economical service wherever installed. Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company, 25 Broadway, New York 4, N. Y., Sales Offices in Principal Cities.

40512
*Reg. U. S. Pat. Off.

Densheath

* **TYPE
T† & TW†
BUILDING
WIRE**

FOR WANT OF WIRING

Electrical laundries are amazing. Pour in the clothes, push a button. When the washer stops, take out the clothes, drop them in the dryer, push another button, then lift out the clean dry garments ready for ironing. You'll see them around the appliance shows and they are just as good as they look. You'll want one.

If you reluctantly lay down the paper evenings to help with the dishes in these maid-less days, you'll lay cash on the line for one of the new dishwashers and garbage disposal units. And one of those full length bathroom heaters is an irresistible touch of practical luxury. The appliance manufacturers are doing themselves proud these days in brilliant design and labor saving utility.

Being practical men with knowledge of such things, we read the nameplates. We note the wattage on these new appliances and wonder about wiring. What will a 4 kw. dryer, for instance, do to the average wiring system? What about the neighbors with their cute little rose-covered cottage, served by a pair of 10's and a 4 circuit box already complete with pennies? They think they're going to buy electrical living and just plug it in. Some folks will try. And then it won't be long before a great era of electrical development is brought to a grinding stop for want of wiring.

Where adequate wiring bureaus have done their excellent spade work there is sound planning and reasonable wiring capacity in new houses. But discussion and planning for modern high wattage appliances in existing homes is limited today to a few industry committees trying to cut down the cost of range installations. Urgent as that problem may seem, its solution is far less important than the immediate need for realistic appraisal of future electrical requirements and a sound and courageous program of rewiring to open the way for electrical living.

The reason for high range installation costs is lack of adequate capacity in the original wiring installation.

Sometimes it was lack of foresight, more often it was plain penny-pinching. Rewiring will cost a lot of money. Maybe with experience, new materials and new methods the costs can be reduced substantially. But it would be the worst kind of industry malfeasance to rewire today without sufficient capacity for the high wattage appliances that are bound to become as common as the refrigerator or washing machine.

We have frequently emphasized here the critical position of electrical construction men in the future schemes of the industry. It is nowhere more clear than in rewiring. For want of wiring electrical living can fizzle, the rosiest of load building opportunities can be halted. Yet, at a time when enthusiastic cooperation of the best contractor brains and skill is most sorely needed, we find leaders in other branches of the industry too often concerned with ways and means to cut costs and shunt out normal distribution channels.

Industry history has proved repeatedly that cutting wiring costs can be intolerably expensive, that when cost is paramount the easiest and most obvious solution is to leave out copper and outlets, that when profits are squeezed out the more enterprising contractors turn to other fields, and tight wires begin to strangle a growing industry.

We need contractor leadership in a rewiring job that will clear the way for electrical living and the most aggressive all-industry teamwork. It cannot be done by halves. It cannot be done cheaply. For those willing to look to the future with confidence and courage, it is a great challenge—and a great opportunity.

Wm. F. Stuart

Electrical Contracting

JUNE, 1946

which of these
do YOU use?

TOOLS

Here's an authentic list of the tools that are commonly used by electrical contractors today. By checking your stock of tools against this list, you can see how well equipped you are to handle a full range of electrical installations.

As you know, possession of all the right tools for each job is a big help toward getting the job done properly and quickly. Moreover, the best equipped contractor is the one most likely to get the biggest contracts.

Graybar — time-saving source of all the apparatus and supplies you install — is an equally convenient source of the specialized tools you need to install them. Probably nowhere else can you get so complete an electrical supply service as Graybar offers. Our nation-wide warehousing system speeds delivery of available items — and the Graybar Specialists near you are always ready to lend a helping hand in selecting and applying the best equipment, supplies, and tools for each job. *Graybar Electric Company. Executive offices: Graybar Building, New York 17, N. Y.*

ELECTRICAL CONTRACTORS' TOOLS (from a list furnished by Electrical Contractors Association of Chicago)

- | | |
|------------------------------------|---------------------------|
| Benches — Large | ✓ K. O. Punches — Sets |
| Benches — Small | ✓ Air Hammers |
| Vises — 1/2" to 2" | ✓ Electric Hammers No. 2 |
| Vises — 2" to 4" | ✓ Electric Hammers No. 4 |
| Thread Cutter — Pr. Dr. | ✓ Reamers — Misc. |
| ✓ Bender — Small | ✓ Files — Misc. |
| ✓ Bender — Large | ✓ Star Drills |
| ✓ Hickies (H. W. C.) — 1/2" & 3/4" | ✓ Hacksaw Blades |
| ✓ Hickies (H. W. C.) — 1" | ✓ Bullpoints — Misc. |
| ✓ Thin-Wall Bender — 1/2" | ✓ Pinch Bars |
| ✓ Thin-Wall Bender — 3/4" | ✓ Socket Wrenches |
| ✓ Thin-Wall Bender — 1" | ✓ Bolt Stock & Die Set |
| Chain Tongs — 1 1/2" — 2 1/2" | ✓ Exten. Cords |
| Chain Tongs — 2 1/2" — 4" | ✓ Burners & Tanks — Gas |
| Reamers 1/2" — 1 1/4" | ✓ Coffing Hoists |
| Reamers 1/2" — 3" | ✓ Chain Hoist — 5 Ton |
| Oilers | ✓ Rope — Hemp 1/2" |
| Drill Press | ✓ Rope — Hemp 3/4" |
| Power Saw — Univ. Band | ✓ Blocks — Snatch & Misc. |
| ✓ Copper Bender | ✓ Wagon Trucks |
| ✓ Iron Bender — Univ. | ✓ Dollies |
| ✓ Tool Grinder — Elect. | ✓ Jacks — Stone |
| Work Bench | ✓ Sledges & Hammers |
| Machinist Vise | ✓ Chain — Coil |
| Forge | ✓ Carpenter Tools |
| Anvil | ✓ Fish Tape 100' — 1/8" |
| ✓ Tool Boxes — Steel | ✓ Fish Tape 100' — 3/16" |
| Tool Boxes — Wood | ✓ Fish Tape 200' — 1/4" |
| Chains & Locks — Ladder | ✓ Winches — Hand Dr. |
| ✓ Ladders — Step 6 ft. | ✓ Winches — Power Dr. |
| ✓ Ladders — Step 8 ft. | ✓ Power Drive — Univ. |
| ✓ Ladders — Step 10 ft. | ✓ Wire Rope 150' — 1/4" |
| ✓ Ladders — Step 12 ft. | ✓ Wire Rope 200' — 3/8" |
| ✓ Ladders — Step 14 ft. | ✓ Cable Pullers |
| ✓ Ladders — Step 16 ft. | ✓ Reel Jacks |
| ✓ Ladders — Exten. | ✓ Pick-up Cart |
| Scaffolding Mat. | ✓ Brake — Cable |
| Tool Grinders — Hand | ✓ Reels — Pay-out |
| ✓ Electric Drills — 1/4" | ✓ Reels & Stand — Gang |
| ✓ Electric Drills — 1/2" | ✓ Strippers — Wire |
| ✓ Drills — Twist, Misc. | ✓ Gas Furnaces |
| Taps — Misc. | ✓ Elect. Soldering Set |
| Whitney Punches & Dies | ✓ Steel Lettering Set |
| | ✓ Floor Crane |
| | ✓ Air Compressor |
| | ✓ Elect. Welder |
| | ✓ Flex. Shaft Grinder El. |
| | ✓ Rolling Scaffold |
| | ✓ Stocks & Dies |

✓ You can get these via Graybar



FREE — Have you seen the "John Watts" booklet? If not, be sure to call or write us for a copy. It's all about you, and we think you'll find it interesting.



THE KEY TO THE HOME OF TOMORROW

IN OVER 90 PRINCIPAL CITIES

Everything for
Electrical Contractors
via **Graybar**

Tested methods used to
combat electrical system
installation and mainte-
nance problems

Wiring for the

PETROLEUM INDUSTRY

THE petroleum industry is an extensive user of explosion-proof electrical equipment. There are, of course, some variances in the diversified branches of the industry, such as the refinery, the producing of the oil field division, the transportation, the general marketing, wholesale marketing, and the retail marketing or service station divisions. For the sake of brevity and conciseness, this article will deal with applications only in the refinery division,

By G. A. Hausske

Electrical Engineer
The Pure Oil Company
Chicago, Illinois

the major and most critical branch of the industry and the one in which explosion-proof equipment is most vitally needed. Such applications for the other branches would follow the same general principles.

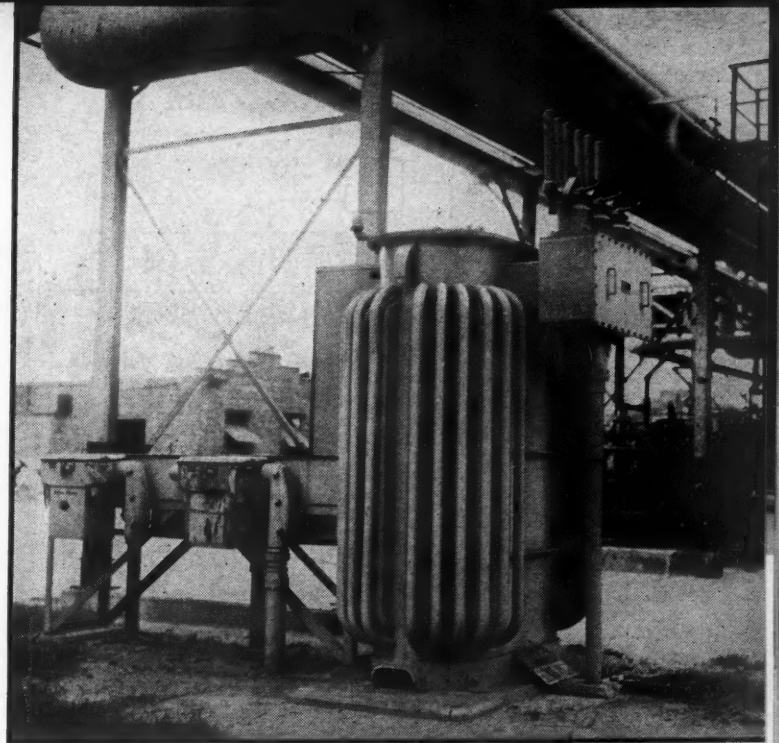


FIG. 1—Typical unit substation for oil refinery use, designed by The Pure Oil Company engineers, is a combination of oil-insulated transformer, oil-fused, gang-operated primary cutouts, weatherproof secondary oil circuit breakers and a secondary bus enclosure.

In an oil refinery, the products handled—gasolines, naphthas, crude oils, refined oils and other liquid petroleum products—give off vapors which, when mixed with the surrounding air to a certain proportion, may become explosive. When such vapors are subject to an arc or flame within a piece of electrical equipment, device or conduit, it is necessary to use explosion-proof equipment and fittings to confine the effect of the resultant explosion.

Equipment and fittings for use in refineries come under N.E. Code Article 500, Section 5005, "Class I" Classification, Group D atmospheres and are so labeled.

In general, such equipment is used in hazardous areas in refineries. All necessary items may not, however, carry the label because of lack of facilities or time for testing all items. The manufacturers are, however, producing many items for hazardous locations made in accordance with the Underwriters' specifications. Where labeled items are not available, others—properly made—are substituted.

Where no approved nor suitably made items are available, they must be designed by the electrical construction engineers to suit the need. An interesting example of this illustrates what can

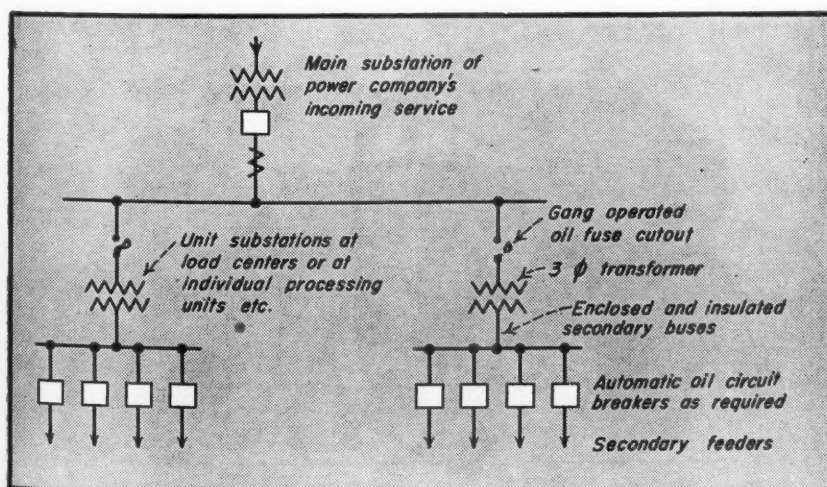


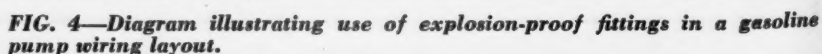
FIG. 2—One-line diagram of explosion-proof unit substation connections.

SERVICE EQUIPMENT SHOULD BE PLACED IN A SAFE AREA



- 1—See N. E. Code, Rules N00, N08a1, N08a3, and 3203d.
2—See N. E. Code, Rules N00, N08b2u, b2w, b2x, Exceptions 2 and 3, 1005, 1005e, f, 3203d, f, and the table on pages 43 and 44 of this section.
3—See N. E. Code, Rules N08e, cl, c2, c4, c5, and 3203f.
4—See N. E. Code, Rules N08e, cl, c2, c4, c5, Exception 2, and 3203f.
5—See N. E. Code, Rules N08e, cl, c2, c4, c5, c7, 1004, and 3203f.

To attain the advantages of unit substations and to safeguard against the hazards in some of their installations, The Pure Oil Company's electrical engineers designed special unit substations suitable for oil refinery conditions. One of these is shown in the accompanying Fig. 1. A typical single-line diagram of the connection in these substations is shown in Fig. 2. Four such installations gave excellent service for the past four years. Several others, somewhat modi-



Our approach to the selection of electrical equipment for hazardous areas is guided by two prime considerations—mechanical and electrical features and advantages. In our particular field we base our choice on the factors discussed below.

Motors—Electrical Factors

Since there are essentially no mechanical variations in different explosion-proof motors our selection follows these rules (based on electrical characteristics):

In the smaller sizes ($\frac{1}{2}$ hp. and up), three-phase motors are preferred since they eliminate maintenance of any contact-making devices such as the centrifugal switch on the single-phase units.

Medium rating motors are generally all fan cooled, ball bearing, grease lubricated types. Speeds of 3600 rpm., predominate since most applications are for centrifugal pump drives. These are a few applications of 1800, 1200 and 900 rpm. motors.

Frequently, because of size, large motors are not built like an ordinary explosion-proof unit. They sometimes are of the totally enclosed type with provisions made to draw in an exhaust air through their windings from an outside, non-hazardous source. In some cases, where an inert gas such as carbon dioxide is introduced, the motors are provided with surface air coolers.

Controls—Mechanical Factors

Physical size and mechanical construction have an important bearing on selection of explosion-proof electrical control equipment. Enclosures for such equipment are inherently bulky since they are designed to confine a possible internal explosion within the enclosure and thus prevent ignition of any surrounding vapors. Since explosion-proof fittings, as well as equipment, can "breathe" there is a good chance of an explosive mixture being within the enclosure. If the pressure created by an internal explosion is sufficient to eject the gas, the mixture must be cooled and quenched when passing between the cover joints to prevent outside ignition. Hence the use of wide, machined surfaces—without gaskets—on electrical control enclosures.

Sealing fittings are installed in conduit lines to explosion-proof motor and push-button control. Note motor frame ground.

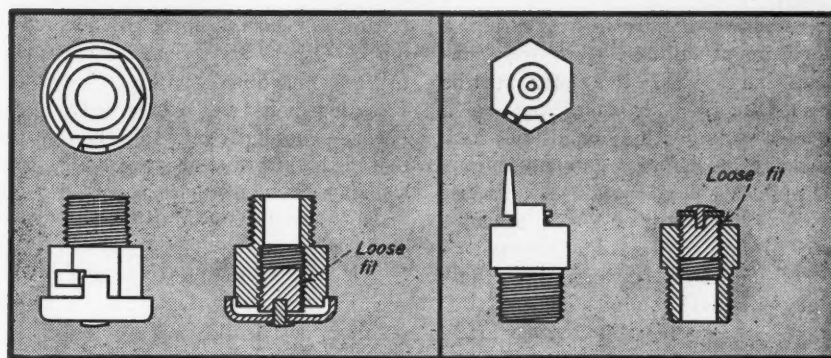
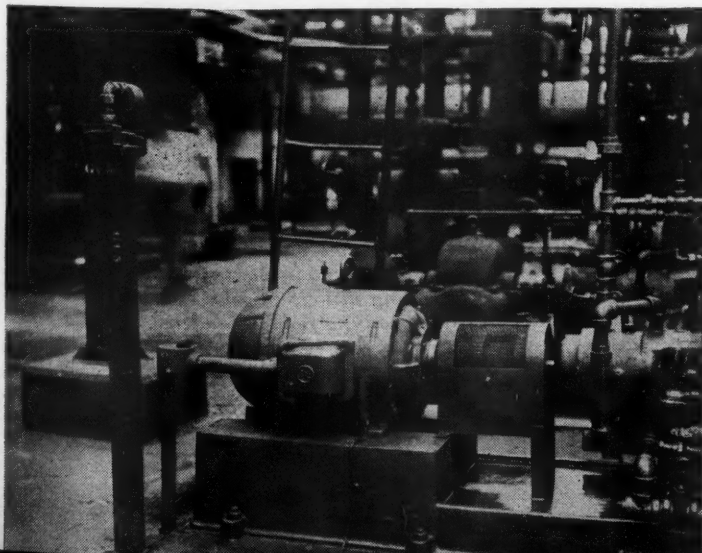


FIG. 5—Explosion-proof vent plug (A) and drain plug (B) used to reduce condensation and moisture in motors and equipment enclosures. Air and water pass over loose fit of threaded plug which also provides sufficient surface to cool and quench any gases which might be ejected from equipment.

Because of size and weight, the question of air break versus oil immersed control contacts is important to the purchaser of explosion-proof equipment. Comparisons of motor controls and switches reveal the following facts:

1. In the smaller ratings, cast-iron enclosed, air-break units are more compact than oil-immersed types.
2. For medium ratings, cast-iron enclosed, air-break and sheet-steel enclosed, oil-immersed apparatus will be approximately the same size.
3. For large apparatus, oil-immersed units are preferred since the cast-iron enclosed, air-break types become excessively heavy and bulky.

Stacked against the disadvantage of requiring oil which must have its dielectric strength maintained, oil-immersed apparatus—in all but the very low ratings—have the following advantages:

1. More compact.
2. Not subject to internal explosions because oil protects arcing points from explosive vapors.
3. Not subject to corrosion of internal parts.
4. Less chance of unit "breathing-in" vapors, moisture or mildewing since

substantial portion of interior area is oil-filled.

5. Easier to open for inspection and maintenance.

Air break apparatus, on the other hand, requires no oil. However, the following factors must be considered:

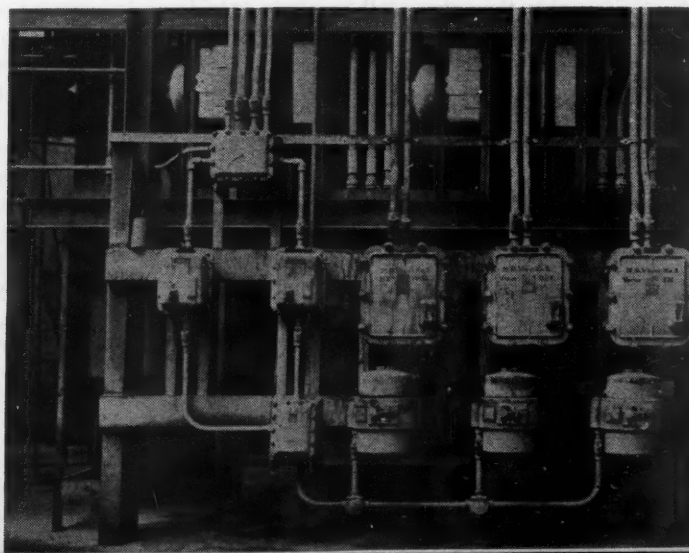
1. It is large and heavy in higher ratings.
2. The machined surfaces of the heavy enclosures must be kept free of rust.
3. Numerous screws must be removed to open unit for inspection and maintenance. There is a danger that the replaced cover may not be tightened sufficiently to make the unit safe.

The excessive size and weight of explosion-proof electrical equipment are serious disadvantages and present a definite installation and maintenance problem. It is our hope that sufficient development in the fields of the lighter metals—such as magnesium and aluminum alloys—can be made to permit their use for such explosion-proof electrical equipment enclosures.

Controls—Electrical Factors

Magnetic starters are used extensively to secure undervoltage protection (to

Complete explosion-proof installation with a rack of air break starters and disconnects.



prevent automatic restarting after a voltage dip or failure). For some important drives, where the motor must be protected against dropping out on a monetary voltage dip, explosion-proof, time delay, pushbutton control stations are installed. These permit selection of time delay ranging from $\frac{1}{2}$ to $4\frac{1}{2}$ seconds.

We prefer combination, across-the-line, oil-immersed starters. Not only do they eliminate conduit and wire connection between the switch and starter, but have a mechanical interlock that prevents lowering the tank when the switch is "on". They are compact and have flexible conduit entrances.

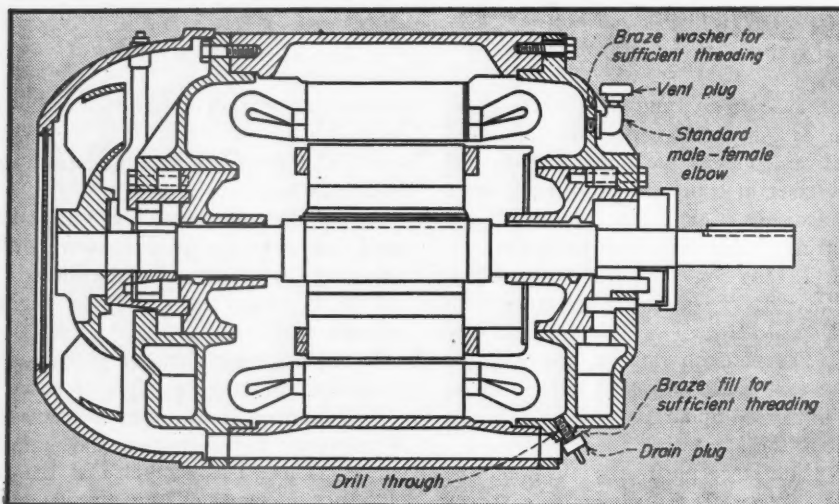


FIG. 6—Installation of explosion-proof vent and drain plugs in the end bell of an explosion-proof motor.

These controllers are available with two types of short circuit protection ahead of the starter: (1) air-seal, oil-immersed fuses; and (2) thermal circuit breakers. Generally speaking, we prefer the air-sealed, oil-immersed fuse type of protection since it provides a suitable, definitely assured, interrupting capacity and fifteen years experience with this type has been consistently favorable.

Thermal circuit breakers in medium sizes have been used recently and are giving satisfactory service. However, in the low rating group, we believe the fuse offers greater assurance of protection than the small breakers insofar as being able to stand up under heavy faults is concerned.

Fittings—Screw vs. Flat Covers

Differences of opinion exist as to the relative merits of the two general types of explosion-proof electrical fittings—those with threaded screw covers and those with machined surface bolted covers. Some contend that the element of human carelessness (neglecting to properly tighten the screw cover)

creates a hazard with the threaded cover units. Others argue that this can apply to the machined surface covers—if fastening bolts are not properly tightened. Another contention is that the threaded joint of the screw cover offers a better flame-quenching path in case of an internal explosion.

Our practice at The Pure Oil Company has been to install fittings which, because of their own particular size and features, best fit the specific application. *The element of carelessness has no place in the installation and maintenance of electrical systems in hazardous locations—or in any other area.* We make

certain that all men who devote any time to such work are trained by us from the start to exercise care.

A good general idea as to where explosion-proof fittings are used in an electrical installation is presented in Fig. 3 and Fig. 4 (manufacturers' diagrams). Other detailed information can be secured from manufacturers' literature and the National Electrical Code Handbook.

Installation and Maintenance Precautions

Normal care, of course, should be exercised in the installation of any electrical system. In the case of hazardous areas, however, additional care must be taken because of the very nature of the equipment handled. A loose connection or fitting cover or improper sealing may lead to a disastrous explosion and fire resulting in severe damage or loss of life. The same precautions for electrical connections apply as are used in standard systems. From the mechanical standpoint, several additional precautions are necessary.

Sealing Fittings

An explosion-proof electrical system must be properly "sealed" to prevent an internal explosion in a contact-making device from traveling through the conduit to other points. Sealing fittings, filled with the proper compound, are installed:

- In each conduit run entering and leaving the enclosure of a contact-making device (switch, circuit breaker, etc.).
- At each motor, although the leads of an explosion-proof motor are sealed at the frame where they enter the explosion-proof terminal box.
- In each conduit run where it passes from a non-hazardous to a hazardous area.
- In long conduit runs, between the main fittings.

Handling Equipment

As mentioned previously, explosion-proof equipment is designed and constructed to confine internal explosions within the enclosure and prevent ignition of outside vapors. Whether or not it will do so effectively depends, to a considerable extent, upon proper installation and handling. Damage to machined edges of enclosure and fitting covers can prove costly. In all of our plants we require that the following precautions be taken.

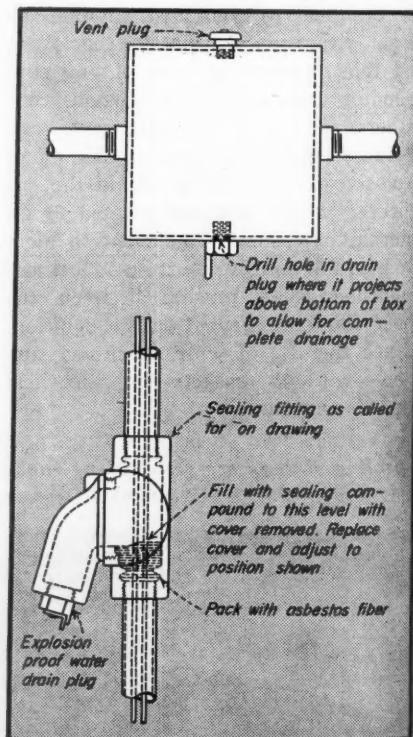
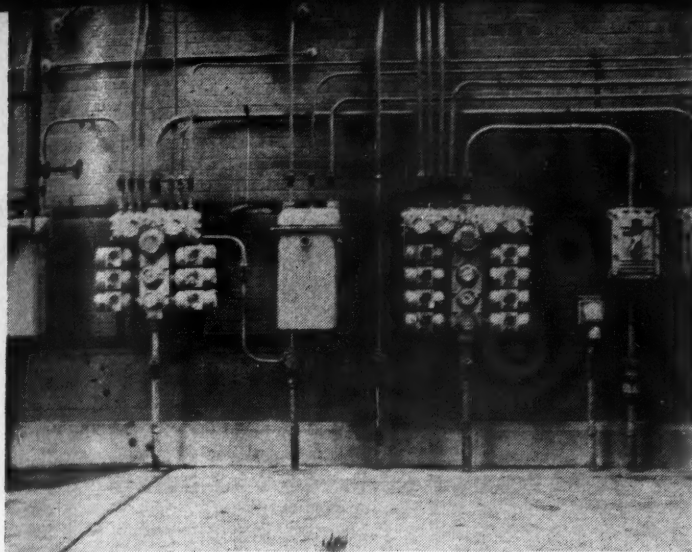
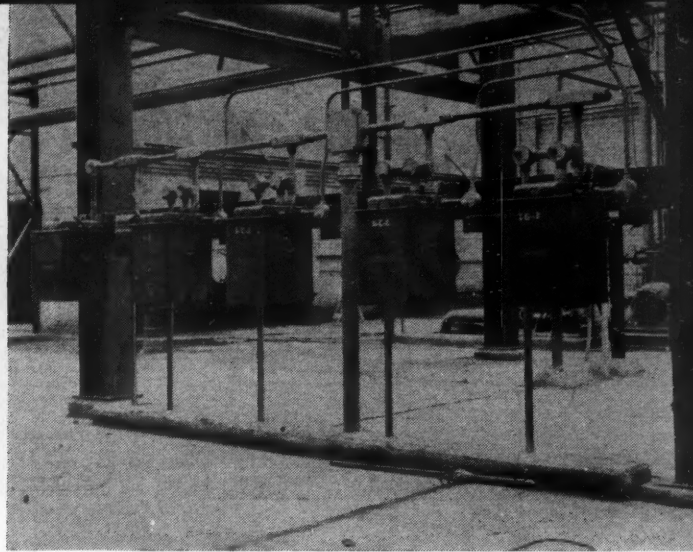


FIG. 7—Vent and drain plugs are used on junction boxes (A), etc., and sealing fittings (B) by The Pure Oil Company to reduce condensation and moisture in conduit systems.



Explosion-proof installation with both oil-immersed and air circuit breaker starters. Lighting panels are explosion-proof type.



Outdoor rack with oil-immersed starters and explosion-proof sealing fittings. Standard fittings used on runs beyond sealing fittings.

1. Prevent damage to machined edges of motor frame joints, equipment enclosure covers and fitting covers.

2. Make certain such surface is clean (free of rust, dirt, grit, etc.) and dry when assembled.

3. Prevent damage to threads on screw cover devices and bolt threads on machined surface units.

4. Tighten all screw covers securely and adjust set screws to prevent loosening from vibration. Tighten all bolts on machined surface covers evenly and securely.

5. Make certain that all operating plunger shafts (such as automatic reset buttons) on explosion-proof equipment are free of corrosion and dirt.

6. Use explosion-proof unions instead of "running threads."

7. All conduit connections must be "lead" and tightened to a full five threads or more.

Moisture Protection

Making an electrical installation explosion-proof is not enough; it must be trouble-free as well. Hence, added precautions are necessary, particularly where damp climates, condensation and mildewing are prevalent.

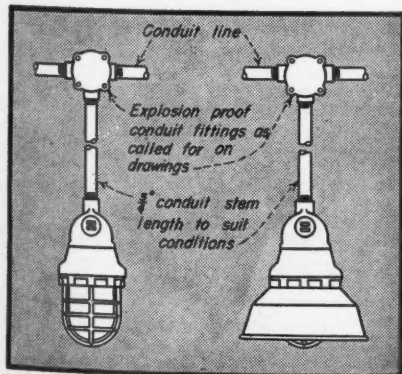


FIG. 8—Installation technique for explosion-proof lighting fixtures.

We have found that where intermittently operated explosion-proof motors are located out of doors and subject to direct sun and rain, "breathing" frequently occurs. This moisture content of damp air sucked in during the day is condensed at night. Such an accumulation of condensed moisture may, in time, reach the lower portion of the motor windings and cause insulation deterioration and failures.

Our solution to such failures is to install explosion-proof vent and drain plugs—a comparatively recent development of the manufacturers. The vent plug (Fig. 5-A) permits enough air to enter the enclosure to equalize temperatures within and without so condensation is reduced; by the same means it reduces mildewing on the interior of oil-filled equipment. The drain plug (Fig. 5-B) permits checking enclosures and draining them of any condensed water which trickles out over the loose threaded fit of the plug.

In the case of the motor, the vent and drain plugs are installed at the top and bottom of the end bell respectively (Fig. 6). Applications to equipment enclosures and sealing fittings are illustrated in Figs. 7-A and 7-B.

At one time a number of failures were experienced on lead covered, braid and rubber insulated cables. We found that this occurred most frequently where mildew and condensation were prevalent in fittings. The braid absorbed the moisture in the fitting and as a result of a "wicking" action, the water seeped down between the braid and lead sheath.

To overcome this, we required that this type of cable be thoroughly sealed where it leaves the lead sheath and that the exposed braid covered cable be painted with a good quality lacquer. Since this precaution was taken, no moisture failures were experienced.

Grounding

Grounding of explosion-proof electrical systems need not be more elaborate than that for standard installations. It must, however, be complete, of the best construction, and entirely protected from mechanical damage. The grounding system should be designed to provide at least two parallel paths to ground.

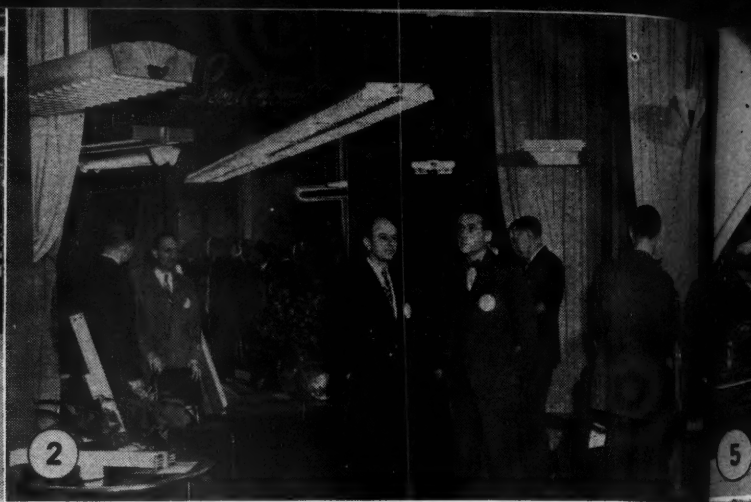
As a rule, the primary consideration in conventional grounding is one of personal safety from electric shock. In explosion-proof work, the additional precaution against possible arcing from loose ground connections or static electricity must be considered. This also applies to storage facilities which must be protected against both static and lightning discharges (See "Control of Static Charges," E.C., Oct., 1945, pg. 161; "Control of Stray Currents," E.C. Nov. 1945, pg. 157).

Borderline Cases

What to do when approved equipment is not available? There are some instances where heavier types of equipment, starters, switches, etc., are of such a size and nature that U.L. standards and testing facilities may not be available and hence do not carry Class I, Group D approval. Such equipment, constructed along explosion-proof lines, may still be obtained from manufacturers and should be used in preference to other equipment not so constructed.

Oil immersed apparatus, where all electrical connections, terminals and contacts are at least six inches below the normal oil level, may be construed as essentially explosion-proof and should be used in preference to other equipment if Underwriters Laboratories tested and approved items are not available.

[Continued on page 179]



Contractors at LIGHTING SHOW

ELECTRICAL contractors occupy a key position in the lighting industry. They have a keen interest in lighting plans and lighting sales for the big market ahead. This was forcibly demonstrated by their attendance at, and participation in, the International Lighting Exposition, held in Chicago, April 26-30.

The Exposition was sponsored by the Industrial and Commercial Lighting Equipment Section of the National Electrical Manufacturers Association. It was supported by over 80 exhibitors, consisting of manufacturers of lamps, lighting equipment and components, trade publications, trade associations, the Illuminating Engineering Society, and others, occupying over 125 exhibit booths in the Exhibition Hall of Chicago's mammoth Stevens Hotel.

In addition to exhibits, the Exposition embraced a series of four conference forums, or round table discussions. Two of these were for all segments of the lighting industry, one was a lighting sales forum for electrical contractors, and the fourth was on lighting service and lighting application

for utilities. Capacity audiences attended each meeting.

Highlights of the lighting sales forum for electrical contractors were three talks: one describing a program for developing more lighting sales, by W. H. Robinson, Jr., advertising manager of the General Electric Lamp Department; one covering fluorescent lighting maintenance as a basis for increasing lighting sales, by Harris Reinhardt, commercial engineering department manager, Sylvania Electric Products, Inc.; and one by S. C. Sachs, electrical contractor of St. Louis, outlining practical sales methods for the electrical contractor.

S. B. Williams, past president of the Illuminating Engineering Society, and editor, *Electrical World*, set the theme for all conference sessions in a keynote address, when he challenged the industry to Relight America.

Total attendance at this Exposition, first of its kind to be participated in by all parts of the industry, was over 10,000. NEMA has announced that a second Exposition will be held in November, 1947, exact date to be set later.



1 Walter C. Handy, electrical engineer, Shell Oil Co., N. Y., (left) and Charles M. Beltzhoover, electrical contractor, Cincinnati, with Sylvania Electric Products sales engineer F. J. Heintz.

2 Fluorescent fixture exhibits attracted many visitors, as shown by this typical scene.

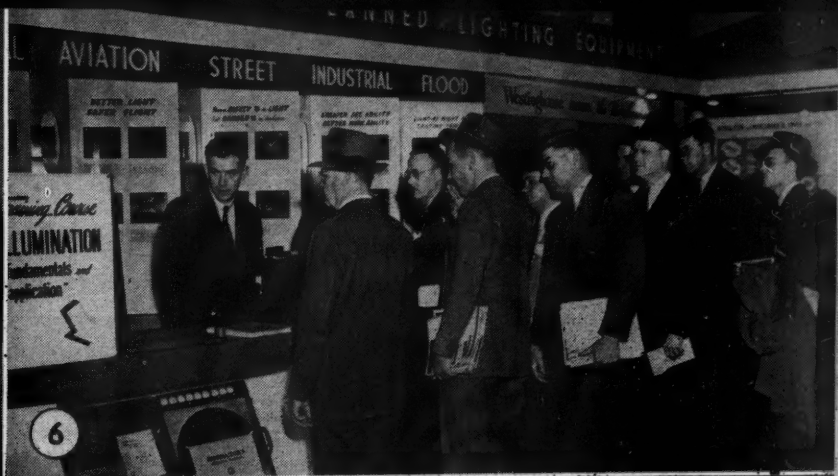
3 Much credit for the success of the Lighting show goes to R. W. Staud (left), Benjamin Elec. Mfg. Co., Chairman of the Exposition Program, Publicity and Attendance Committees, and to E. C. Heerkamp, Westinghouse Elec. Corp., Exposition Chairman.

4 Electrical Contractors Fred Stoeck (left), Vice President of Hoffman Electric Company, Chicago, and Charles E. Reis, Vice President, White City Electric Co., Chicago.

5 P. H. Massman, Crouse-Hinds Co., demonstrated automatic cellometer to F. W. Martin, Graybar Electric Co., Chicago (center) and Geo. H. Kelley, electrical engineer, Kelburn Engineering Co., Chicago (right).

6 Training courses in illumination received undivided interest of visitors. Many courses now available were discussed in conference sessions.

Oil
over,
Elec-
vis-
show
Mfg.
blicity
lamp.
Vint
icago,
electr-
trates
paybar
elley,
icago
und
avail



7 Wm. E. Stevens, Wayne Cook and Virgil Cook of Virgil Cook, Electrical Contractors, and L. A. Swanson, Lighting Engineer, Central Illinois Lighting Co., Dekalb, Ill.

8 Visitors look over large assortment of floodlighting equipment.

9 H. I. Dalzell (left), The Thompson Electric Company, demonstrates a fluorescent fixture hanger.

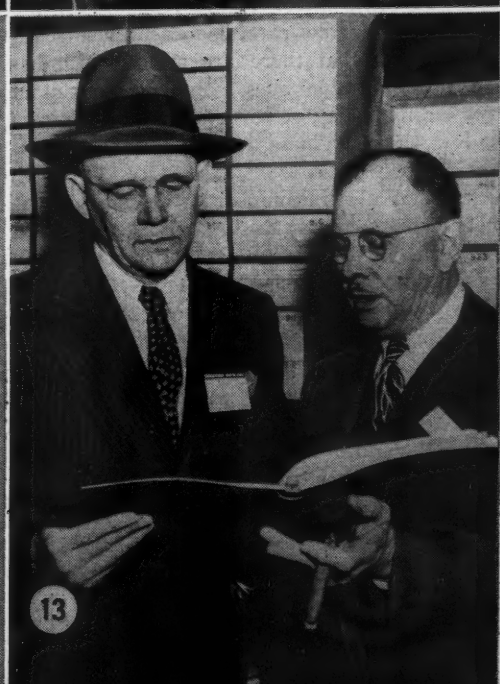
10 Exhibits featured both hot and cold cathode fluorescent and incandescent lighting units.

11 J. Groben, Althoff-Howard Electric Co., Bill Powell, Swanson-Nunn Electric Supply Co., and H. F. Roettger, H. F. Roettger Electric Co. (left to right), all contractors of Evansville, Ind.

12 E. C. Madsen, (left) and M. M. Hanson, Apprentice Training Service, U. S. Dept. of Labor, with electrical contractor B. H. Barg of Milwaukee.

13 Ray W. Ashley (right) Research Engineer, Electrical Contractors Association of City of Chicago, discusses estimating with Electrical Engineer Frank W. Matten, Corn Products Refining Co., Pekin, Ill.

14 Visitors look over exhibit of infra-red and germicidal lamps.



By Charles L. Amick
General Electric Company
Nela Park Engineering Division
Cleveland, Ohio

COLOR is important to everyone who sees. It has certain powers that merchants want, others that office managers and industrialists need. For example, in one test some years ago it was found that when colored lighting was substituted for white the number of passersby stopping at the show window increased 290 percent and the number of people entering the store nearly doubled. Yet in many respects the field of light and color has been untouched.

The electrical contractor who expects to capitalize fully on the rapidly expanding lighting market will want to do more than install fixtures and make an occasional maintenance call. The additional service of providing advice on all phases of lighting may at first thought seem to be an unnecessary loading of already overworked personnel, but it pays great return not only on the balance sheet but in customer satisfaction and prestige to you. Knowledge of the role that color plays in lighting should be an important chapter in your "service" manual.

There are virtually unlimited possibilities to create decorative, esthetic and useful treatments of light and color. Whole volumes have been written on this subject, but it is the purpose of this article to mention briefly some practical aspects which can be applied by every contractor in every city. Applications vary widely, from the relatively simple problem of recommending the color of fluorescent lamps for a neighborhood grocery meat display to more complicated industrial inspection tasks where small color differences must be detected. Considerations of color measurement and specification will come up and decorative aspects must be weighed. The whole subject is already a complex scientific field of study, but this does not mean that the electrical contractor must avoid color and its application. Let's take a quick look at some fundamentals.

What Is Color?

The definition of color is almost as basic as the definition of light itself. Color actually exists in light; we see color because objects reflect light of

Color plays an important part in every artificial lighting installation. It is important in decorative color lighting effects. It is equally important, although perhaps less consciously so, in so-called "white" lighting installations. Recognizing this, we have had the accompanying authoritative article on color as it relates to lighting prepared to supplement the *Lighting Techniques* series of articles appearing in *Electrical Contracting* for the past several months. — EDITOR

certain colors more efficiently than other colors.

Most illuminating systems use general lighting of a "white" quality. Sir Isaac Newton of "falling-apple" fame discovered in 1666 that sunlight or white light is made up of all colors. We now know that the proportion of the different colors determines the more exact specification of "whiteness." Two examples are the light from ordinary tungsten-filament lamps which has an abundance of orange and red, and north skylight which has more blue than red energy. In any case, however, the color appearance of objects depends on (1) the color content of the light with which they are illuminated, and (2) the reflectance characteristics of the objects themselves. A third factor is the response of the eyes; while careful measurements indicate that there are around 150 distinguishable hues, some people cannot differentiate a normal number. This is color blindness to one degree or another.

While the number of detectable hues (pure colors) is limited as mentioned above, there are 10-20 thousand tints and shades. Coupled with the effects of brightness, the figures quickly get into millions. Light greatly outstrips paint in ability to produce different variations in color effects.

It is very difficult to show graphically the difference in the appearance of colored materials when lighted by two or more sources of illumination. The

treatment in *LIFE* Magazine some months ago indicated how filters and other transmitting materials can be used to cut out certain colors but few objects have reflectance characteristics with such sharp cut-off points. The accompanying table indicates some of the changes which take place under filament lamps and three types of fluorescent lamps producing "white" light. The problem of portraying such effects is complicated by the two step process of color photography and color printing; neither gives reproductions which exactly match the visual sensation. Whenever color appearance is important, the selection of fabrics, paints, carpets and other furnishings in commercial establishments and homes should be made by actually seeing the material under the light sources to be employed. A simple box containing daylight, 4500° white, 3500° white, and soft white fluorescent lamps, with provision for filament lamps and suitable switching facilities will prove invaluable in this regard. For example, pure colors usually change less than tints or mixtures in switching from one white to another. However, the appearance of materials having complex spectral reflectance characteristics when illuminated by fluorescent sources which have complicated energy distributions is often impossible to predict.

The question of paint and furnishing colors for stores, offices and homes is largely a matter of customer preference. However, the contractor can suggest combinations of finishes and light sources which are pleasing in appearance. The box arrangement mentioned above can be made small enough to be conveniently portable, in which case the contractor can perform a real service in assisting the customer visualize the appearance of finishes and materials under different light sources, or select the lamps on the basis of the finishes to be used in the interior. So many installations of daylight lamps with warm-toned wall finishes which go pretty flat indicate the need for making actual tests of this nature. Too, colors seen alone may look better than combinations of colors and the test described will reveal complications of this nature. With the variety of

COLOR in

LIGHTING

The definition of color, its use in lighting, and other practical aspects of its measurement, specification or application are given for use by those who plan or sell lighting installations.

light sources now available the opportunity for flexibility and customer satisfaction is greatly enhanced.

Color Measurement and Specifications

There are three properties of color which can be used in measurement and specification. These are hue, saturation and brightness. Hue has been called the "colorful" part of color; it is that quality which is described as blue, green, yellow, etc. Saturation indicates the degree to which a color is a pure hue or a "dilution" with white. In the color language, brightness tells the percentage that a surface reflects as compared to a perfect 100 percent white. It is therefore the reflection factor of the surface to light of a given spectral quality. The reflection factor of a given surface may vary for different sources, depending on the reflectance characteristics of the surface and the color content of the lamp outputs.

There are three fundamental ways to specify color. The first and most common is by indicating the hue or tint, such as pea-green, sky-blue, lavender, rose, etc. But with such a system there is little assurance that what represents pea-green in your mind coincides with another person's conception of that description. For example, in one test a group of 38 observers used eleven different names to designate a single light red sample. Because words are so indefinite, other more concise methods of color specification are frequently employed.

The second method used to specify color is the Munsell System which classifies color by qualities of hue, chroma and value. Nine major hue classifications are in turn broken down into steps of chroma (color) and value (saturation). The Munsell color classifications are easily demonstrated by a book giving samples of each step.

The color of any light which reaches the eye can be specified in a third way by a spectral distribution curve or by a point on the ICI color diagram, the latter calculated from the former or measured directly. The letters "ICI" stand for International Congress on Illumination

TABLE 1

APPEARANCE OF SOME PAINTED COLOR SURFACES UNDER FLUORESCENT AND INCANDESCENT-FILAMENT LAMPS

Color names were first assigned to the samples as they appeared under the fluorescent daylight lamp since this light most closely simulates natural daylight. The other color names, reading from left to right, for each color and tint are related as much as possible to those in the first left-hand column. The fact that color changes take place with tungsten-filament lamps as well as with the white and soft-white fluorescent lamps is illustrated.

Fluorescent daylight	Incandescent (60-watt filament)	Fluorescent white	Fluorescent soft white
(C) Grayed greenish yellow	Golden yellow (free from greenishness)	Grayed yellow (slight green)	Yellowish buff
(T) Ivory (bluish)	Deep ivory	Ivory (yellowish)	Ivory (pinkish)
(C) Medium blue	Very grayed purplish blue	Slightly purplish blue	Light purplish blue
(T) Pale blue	White*	Pale bluish gray	Pale bluish purple
(C) Medium brown (coolest)	Medium brown (slightly orange)	Medium brown (slightly warmer)	Medium brown (slightly pink)
(T) Very pale pink	Pale reddish buff	Pale pinkish buff	Grayed purplish pink
(C) Deep purple (bluish)	Deep purple (reddish brown)	Deep purple (less bluish)	Deep purple (reddish)
(T) Pale bluish purple	Pale yellowish red	Grayed reddish purple	Medium reddish purple
(C) Medium green-blue	Medium blue-green	Grayed medium blue	Grayed medium blue (slightly purplish)
(T) Very pale blue	White*	Pale bluish gray	Very pale purplish white
(C) Very grayed dark green	Grayed yellow-green	Grayed green (slightly yellowish)	Grayed green (slightly brownish)
(T) Very pale green-blue	Medium ivory	Pale buff	Very pale purplish gray
(C) Deep rose	Medium red	Grayed medium red	Medium rose
(T) Light pink (slightly purplish)	Yellow-red (very pale)	Light pink (warmer)	Light pink (redder)

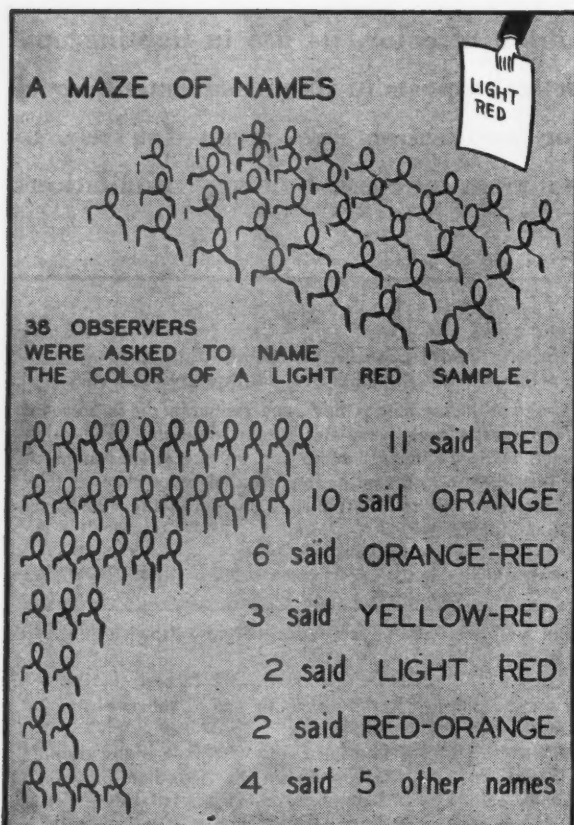
(C) Full color. (T) Tint of color

* In each case, four samples of the same color were viewed under the four light sources at the same time. The starred colors marked white only appeared so by comparison with the other three samples. By turning off the other three lamps and viewing these samples alone, the bluish quality of both returns. Surrounding these samples with a white surface will also cause the bluish appearance to return.

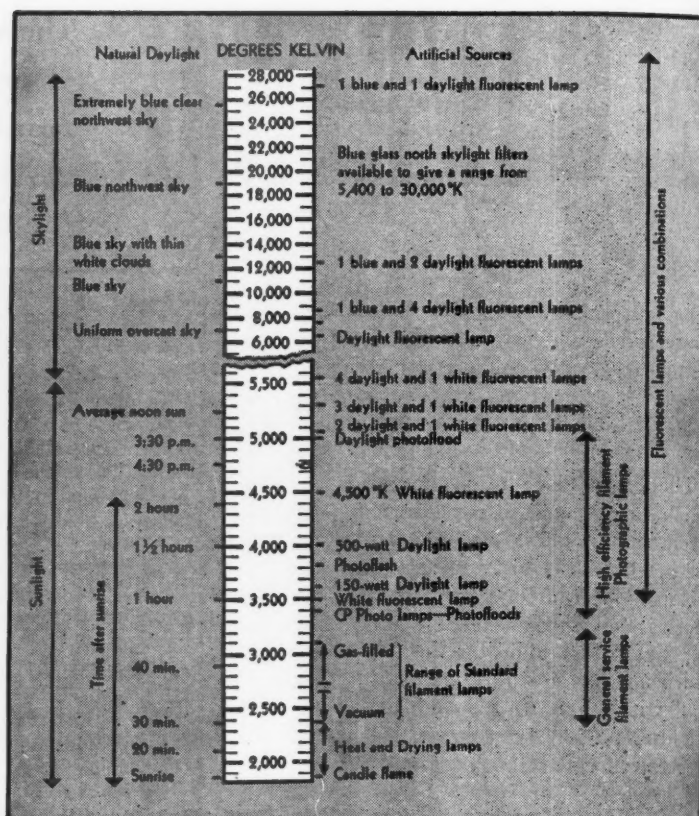
TABLE 2

COMBINATION OF COLORED FLUORESCENT LAMPS TO SECURE VARIOUS COLOR TEMPERATURES

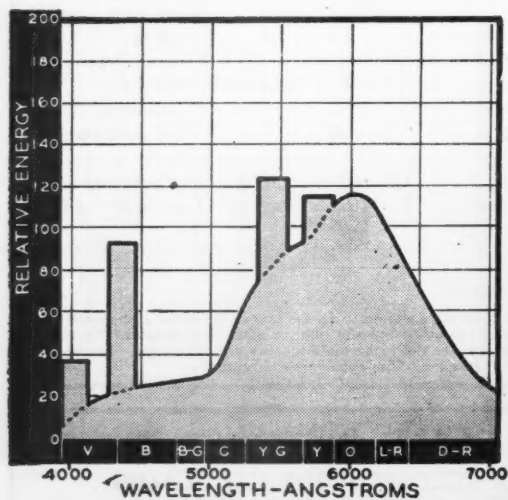
Colors in combination	Per cent of total light to get					
	3000° K.	3500° K.	5000° K.	6000° K.	6500° K.	10,000° K.
Blue.....	17	22	36	40	42	51
Gold.....	83	78	64	60	58	49
Blue.....	2	7	18	25	28	40
Green.....	39	39	39	37	36	29
Pink....	59	54	43	38	36	31
Blue.....	6	11	22	27	30	43
Green.....	61	59	54	51	49	40
Red.....	33	30	24	22	21	17



The tangle of color names as illustrated by a particular test. Notice how the situation gets complicated in Table 1 when names are attempted for the various appearances. Use of names for hue or tint has proved to be confusing, as shown by the above test and other similar tests, indicating the need for a scientific color specification.



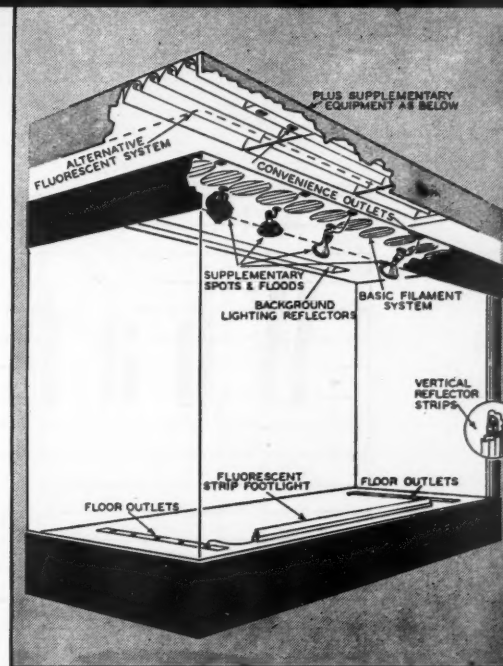
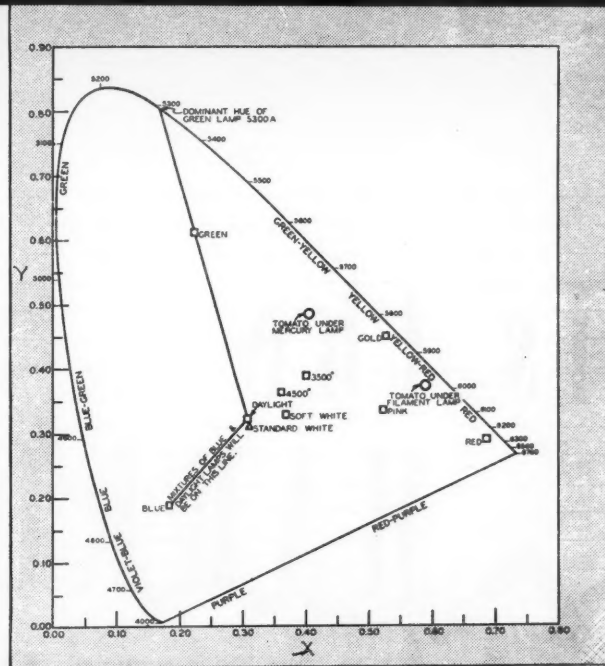
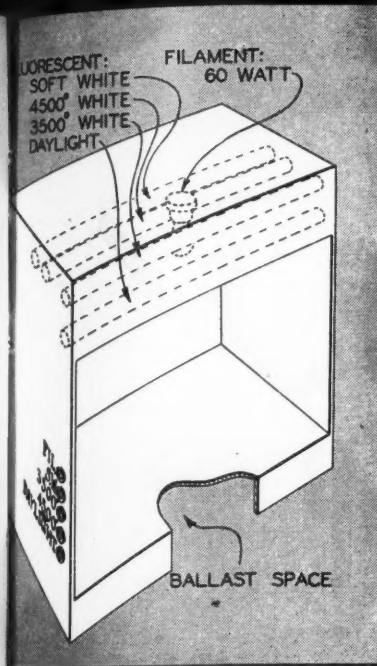
Color temperature, in a popular sense, refers to the degree of whiteness of a light source. Expressed in degrees Kelvin, color temperature values are obtained by comparing the color of the source under test with that of a standard laboratory radiator. Mercury lamps are never assigned color temperature values because the standard radiator will not at any operating temperature match the bluish-green light from such lamps.



The fundamental scientific specification of color is by a spectral distribution curve. Such data can be given for sources (such as the 3500° white fluorescent lamp shown above), for reflecting surfaces and for transmitting materials.

A portable demonstration box with compartments for filament, 3500° white fluorescent, daylight fluorescent, and soft white fluorescent lamps. The filament lamp was a 25-watt reflector show-case lamp and the fluorescent lamps of the 6-watt 9-inch size. Locations were set to give nearly the same illumination in each compartment.





A suggested color box for demonstrating the appearance of material and finishes under the various "whites" available in filament and fluorescent lamps. Made portable, such a color box will prove invaluable in selecting the light source best suited for any lighting application.

The ICI color diagram. The squares represent the standard colors of fluorescent lamps; the triangle gives the location of a standard white (ICI Illuminant C) and the circles indicate the appearance of a ripe tomato under a mercury lamp and under a 100-watt filament lamp.

A typical arrangement of lighting equipment in the show window. It will be seen that there are many places where color can be employed using both filament and fluorescent units. Color frames for gelatins or glass roundels are available for most of the standard reflector units.

which in 1931 adopted this diagram (Top center). The point for the green fluorescent lamp shows that such light can be considered a mixture of pure green (a dominant hue of 5300 Angstroms) and a standardized white. The relative distance from the standardized white to the point representing the green F lamp indicates the saturation of the light; in this case 60 percent.

The ICI chart can also be used to indicate differences in the color of materials under various light sources. The ICI chart has the added advantage of simplifying the resultant combined colors of light. For example, mixtures of daylight and blue fluorescent lamps will fall on the line connecting the points which represent the two sources, the

location depending on the proportions of each.

Using Color

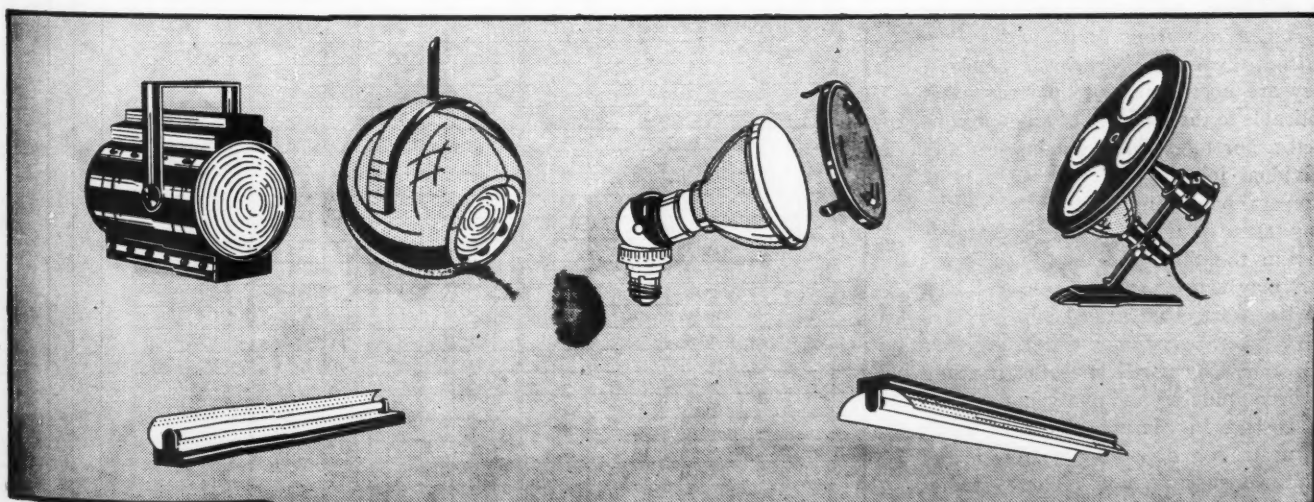
There are six distinct primary sensations: red, yellow, green, blue, white and black. Tints of colors are produced by diluting with white. Shades are associated with brightness. If red, green and blue lights are mixed in the proper intensity, the result is white. This is called the additive method of mixing color and the three colors are termed "additive primaries."

For mixing dyes, pigments, etc., subtractive primaries are employed. These consist of purple, yellow and blue-green which combine to give black. Purple and

yellow alone give red, yellow and blue-green produce green, and blue-green with purple gives blue.

A word about the psychological "powers" of different colors. There are colors which give the feeling of warmth and those which seem cool. While the tint, shade and apparent small change in hue are factors, the warm colors are red, orange and yellow; the cool colors are violet, blue and green. In general, the warm colors produce a cheerful and exciting influence while cool colors are tranquilizing. Purples, violets and blues can even be subduing. There is also a rich heritage of color symbolism. Red is associated with health, power and anger; red-purple with royalty; reddish

[Continued on page 180]



Equipment for projecting colored light may take the form of conventional spotlights, projector lamps and clip-on color roundels or color wheels as shown on the top row. For

overhead or foot-light type of applications not requiring confined beams, the fluorescent reflectors shown in the lower group are useful.

What is the MARKUP ?

Part III

Two new considerations—"Research and Time Studies" and "Adjustment Factor" are emphasized in this development analysis of the overhead and direct job cost percentage figures recommended in the "Labor Overhead versus Material Overhead" tables for electrical construction work.

By Ray Ashley
*Research and Consulting Engineer
 Chicago, Ill.*

ONE must have a potent incentive to induce him to analyze and study details of overhead costs. The two previous articles on "What is Markup?" were planned to initiate such an incentive. To augment the work of these articles, some facts about the preparation of the tables shown in Figure 2 (M.OH. vs. L.OH.) will be given here.

The purpose of such tables is to assist electrical contractors in analyzing their own operating costs, and in establishing equitable overhead charges. They are not intended to portray costs applicable to the business of any one contractor, nor to establish markup for any individual job.

Several pages might be written on the steps taken to arrive at the percentages used in the tables; a few lines, however, may serve to give a general idea of what work was carried on.

For several years the writer, together with some Chicago electrical estimators, has been studying and analyzing operating costs. In carrying on this work, the costs for supplying material and labor were segregated. These studies embraced direct job expense as well as overhead, and aided a great deal in showing the relative cost of supplying

LOCATION OF WORK		LABOR RECORD HOURS ROUGHING—IN										EST. NO.		
JOB.		MONTH										JOB NO.		
MR. _____ FOREMAN IN CHARGE		DATE										WEEK ENDING _____ 19__		
NON-PRODUCTIVE LABOR		ORG. JOB NO.	CHG NO.	THU.	FRI.	SAT.	SUN.	MON.	TUE.	WED.	TOTAL HRS.	QUANTITY	% PROG.	REMARKS
ERECTING TEMPORARY OFFICE														
PLANNING WORK														
CHECKING DRAWINGS														
TAKING MEASUREMENTS														
GENERAL SUPERVISION														
TIME REPORTS														
INTERVIEWS														
TEMPORARY WORK														
WAITING FOR INFORMATION & MATERIAL														
TESTING														
CLEANING PIPE														
CUTTING & CHANNELLING														
MOVING MATERIAL & TOOLS														
PRODUCTIVE LABOR														
INSTALLING 1/2" - 3/4" COND.														
" 1" - 1 1/2" "														
" 1 1/2" - 2" "														
" 2 1/2" - 3" "														
" 3 1/2" - 4" "														
" CEILING OUTLETS														
" WALL "														
" FLOOR "														
" SPECIAL "														
" LIGHTING C. O. B.														
" POWER "														
" PIPE SUPPORTS														
" JUNCTION BOXES														
" SERVICE CABINET														

FIG. 1—A field report form designed to facilitate recording of field cost data. Note segregation of cost items under "non-productive" and "productive" labor. Diligent use of such a form will lead to accurate field cost accounting.

LABOR OVERHEAD VS. MATERIAL OVERHEAD FOR ELECTRICAL CONTRACTING

APPROX. PERCENTAGES FOR BUSINESS WITH AN ANNUAL VOLUME (BASE JOB COSTS) OF 500,000 DOLLARS
BASED ON SURVEYS OF CONTRACTING FOR A MIXED CLASS OF WORK WITH: (1) AN APPROX. JOB COST RANGE OF 100 TO 80,000 DOLLARS, AND
(2) A CONTRACT RATIO OF "60-40"—60% OF THE BASE JOB COST IS FOR MATERIAL AND 40% FOR LABOR.

EXHIBIT—A (FOR REFERENCE ONLY)
APPROX. DIVISION OF DIRECT JOB COSTS WHICH SHOWS THAT, ON A DOLLAR BASIS,
THE COST OF THE SUPPLY AND MANAGEMENT OF LABOR IS FAR GREATER THAN
THE COST OF SUPPLYING MATERIAL.
NOTE—ITEMS OF DIRECT JOB COSTS SHOULD NOT BE CONFUSED WITH OVERHEAD.

ITEMS OF DIRECT JOB COST	% OF COSTS		REMARKS
	MAT. (60%)	LABOR (40%)	
ESTIMATING	1.05	1.35	SOME PROJECTS ARE ESTIMATED & ENG. SEVERAL TIMES. EXP. ON A SINGLE PROJ. DOES NOT REFLECT COSTS FOR ADJ. BETWEEN JOBS, VACATIONS, ETC. COST OF MISSIONARY WORK IS INCL. IN GEN. OH.
ENGINEERING & DRAFTING	0.80	2.88	
BLUE PRINTING	—	0.1	
FIELD SHOP & OFFICE BLDGS.	0.14	0.19	FOR SPECIAL JOBS—SHOWN AS A PRORATA EXP. OF TOT. VOL.
FIELD TEL.	0.03	0.03	
WIRING & CURRENT—FIELD SHOP & OFFICE	0.05	0.10	
TOOLS—CONSUMED & DEPRECIATED	—	3.50	
SELECTING & PURCHASING MATERIAL	0.75	—	
FOLLOW UP & COORD. DEL.	0.50	—	
CARTAGE & SPECIAL DEL.	0.10	0.10	
SUPERVISION	—	2.60	
TRAVEL EXP.—OFFICE TO JOB	0.10	0.21	
TIME KEEPER	—	0.50	
INSURANCES & EMPLOYEES BENEFITS	—	14.00	REQ. ON THE JOB FOR LARGE CREWS CHICAGO RATES
INSPECTION (CITY)	0.70	0.80	BASED ON CHICAGO RATES
INTEREST ON PAYROLL	—	0.50	CONTRACTOR IS ENTITLED INT. ON MONEY WITHHELD
ASSOCIATION DUES	0.20	0.70	CHICAGO RATES
PRORATA CHARGES	—	0.05	FOR TEMPL. & PR. BROKEN GLASS, ETC.
RESERVE FOR CONTING. & GUARANTEE	0.10	0.50	
TOTALS	4.43	28.11	

①—IN CHECKING OVERHEAD 14.11 (28.11-14.00) IS USED INS (14%) IS NOT REQ TO CARRY THE SAME MARKUP AS LAB.

—THE CHIEF FUNCTION OF ELECTRICAL CONTRACTING IS THE SUPPLY & MANAGEMENT OF LABOR—

EXHIBIT—B
APPROX. DIVISION OF
GEN. OVERHEAD & ADMIN. EXPENSE
ITEMS OF OPERATING COSTS
NOT IDENTIFIED WITH ANY PARTICULAR PROJECT

ITEMS OF OVERHEAD EXP.	PERCENTAGES OF COST	
	MAT.	LABOR
ADMINISTRATIVE SALARIES	2.35	8.35
ENGINEERING & EST. (MISSIONARY WORK)	0.40	1.40
BOOKKEEPING—GEN.	0.92	1.40
BOOKKEEPING—SPECIAL TAXES & INS.	0.20	1.57
STENO. & TEL. OPER.	0.25	0.88
STORE RM. ATTENDANT & SHOP MECH.	0.35	1.23
UTILITY BOY	0.18	0.65
RENT—OFFICE (HEAT INCL.)	0.35	1.23
RENT—STORE ROOM (HEAT INCL.)	0.10	0.35
LIGHT	0.06	0.21
TELEPHONE	0.25	0.50
OFFICE EQUIP. & FURNITURE	0.12	0.43
STATIONERY, EST. FORMS & MISC. SUPPLS.	0.23	0.40
POSTAGE	0.10	0.20
TAXES, LICENSES & LEGAL EXP.	0.12	0.43
ADVERTISING	0.12	0.43
INSURANCE ON EQUIP. & MISCL. EXP.	0.33	1.13
RESEARCH & TIME STUDIES	—	0.40
AUTOS, TRAVEL, & MISC. PROM'TL. EXP.	0.33	1.13
ADJ. FACTOR (NORMAL & 3 BAD YRS. IN TEN YRS. MUST BE MAINT. IN OFF YRS.)	0.20	1.57
TOTALS	6.96	23.89

FIG. 2—Breakdown of overhead and direct job costs for electrical construction work. Note important new items of "research and time studies" and "adjustment factor" for lean years at bottom of Exhibit "B" columns.

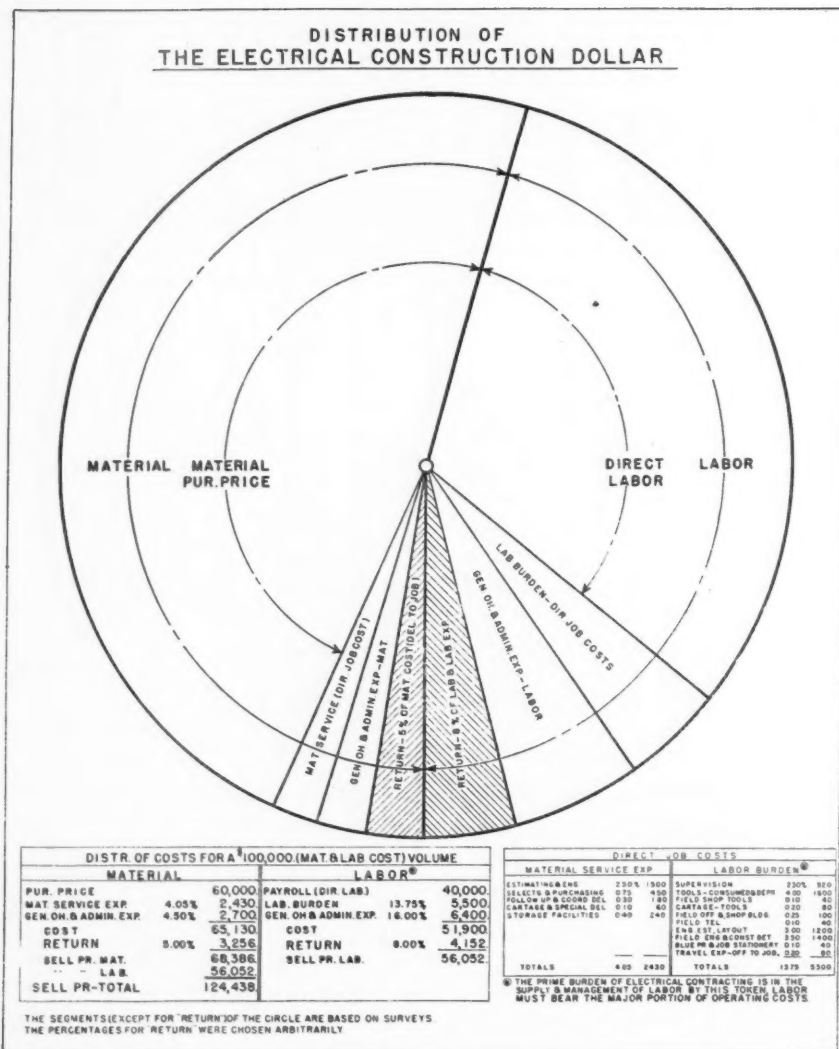


FIG. 3—What the electrical construction dollar would look like if sliced proportionate to various cost items for a normal job (including furnishing of material). Note that greatest portion of operating costs are chargeable to the labor item.

labor as against the cost of supplying material.

Tables and costs were based on a "60/40" (60 percent material—40 percent labor) ratio, because local and national surveys indicate that the base costs involved in the average electrical contracting business have 60 percent chargeable to material and 40 percent to labor. With a "60/40" ratio, for each one dollar of base cost (material & labor) a one percent markup on material would be six cents, and a one percent markup on labor would be four cents.

The estimators who work with the writer have endorsed such figures as are listed in the tables. As for contractors in general, some have agreed that the findings are conservative, others are reluctant to commit themselves, while still others voice such objections as were set forth in the previous article.

Those who have concurred in the find-

ings are contractors who study costs carefully. We have every reason to believe that, in time, similar divisions of material and labor will be generally accepted in the industry as being good business practice.

There is such a thing as one getting so involved in figures that he loses his perspective of general business operation, and overlooks some important influences. Therefore, prior to analyzing any tables, two significant business factors should be considered.

1. From a purely business standpoint, we are not so much concerned in what it costs to supply material as a merchandising item, as we are in how much the operating costs will be increased if we supply it along with labor.
2. If the contractor loses control of the material purchases, how will it affect the cost of the completed job?

To better understand these influences we must consider the following factors not revealed by the tables.

- (A) In order to figure the labor costs, the estimator has to study the plans and specifications, take off the materials and list them, supply missing items, and check the adaptability of all materials.

From a strictly business standpoint, the balance of the expenses of supplying material is all that matters.

- (B) The effect of losing control of the material purchases is an installation-only problem and has not been considered in the division of costs. It is, however, a definite factor of direct job costs.

Divisions Substantiated

Many reasons can be advanced to substantiate the figures shown in Exhibit "B", Fig. 2. The total overall operating costs as shown in the tables (neglecting insurances on labor) is 22.03* percent.

*From "Job" columns of Exhibit "A" and "B":

13.90 (Total "A")—5.60 (insurance) + 13.73 (Total "B")=22.03

Anyone familiar with electrical contracting will not hesitate to admit that it takes an efficient organization to operate at this figure.

Although the reader accepts the overall percentages, he may ask how we know that the divisions between material and labor are correct. We cannot say they are absolutely right, but for every reason that may be advanced to disprove them, there seem to be several which indicate that, for all practical purposes of estimating, they are reasonable. They are figures established without precedent, but based on careful study and judgment of men thoroughly acquainted with operating costs of the electrical contracting business.

Estimators familiar with the costs of supplying material have endorsed figures similar to those shown in Exhibit "A", Fig. 2 as being ample. If we could get an accurate accounting of material costs, in all probability we would find that there is some duplication in the two divisions, (Job Costs & Overhead). Analyses of isolated projects, where all material expenses could be segregated to a fair degree of accuracy, also indicate that the percentages for material are more than ample.

There may be some question about the division of job costs putting too much weight on labor. The three major items

[Continued on page 183]

WINDING AND CONNECTING TIME

Other factors than horsepower and speed provide more accurate measures for estimating time and checking production.

IN past years NISA has annually gathered and tabulated rewinding prices of polyphase squirrel cage motors to arrive at industry average figures. Recently we have gathered figures on rewinding time required for various ratings. In both cases, for various reasons, there has been substantial variation in the figures submitted. In the case of the price tabulations, in the early years, these variations were quite extensive, but in recent years they have become more equalized due to the quite common practice of arriving at such prices by a sliding percentage of the cost of a corresponding new motor.

One of the principal sources of variation in the early years was the practice of basing selling prices on the cost of winding widely varying designs for the same horsepower and speed rating. This, along with variation in shop methods and accounting procedure, resulted in a wide range in prices.

From a selling standpoint, there is no quarrel with the method of using average figures and basing rewinding prices on the horsepower and speed rating as the customer identifies and buys both new and rebuilt motors by the rating. Selling prices are not necessarily in exact relation to production costs. Many other elements are involved such as, simplicity and convenience of basing medium, cost to replace, competition, etc. Just imagine what a complicated set of postal rates we would have if they were based on actual cost of pick-up, transportation and delivery.

The recent tabulation of rewinding time rates, like the rewinding prices, has been based on horsepower and speed

By Geo. P. Svendsen

Boustead Elect. & Mfg. Co.
Minneapolis, Minn.

rating, and, while the average figures compiled are useful in calculating corresponding average, rewind prices, or for general comparison of workers efficiency, they can become a source of trouble if used to set actual workers rates or if used in a worker's point rating system or for bonus payments.

For such use of time studies we must get closer to the actual changes in time due to variation in size and design, which means an entirely new approach to the problem with horsepower and speed rating eliminated as a basing method.

The 5 hp. 1800 RPM motor has always been a popular rating which competition has equalized more than most ratings, but a glance at the following list of such ratings shows there is still a substantial variation in design

with corresponding time differences in winding. In many of the larger horsepower ratings the difference is even greater.

The data below was taken from winding data cards and may have some slight errors in core size, wire turns and weights. Winders are not always careful in recording exact data.

The slot factor in the listing below is a measure of the tightness of the coil in the slot, and is obtained by dividing the number of wires in the slot by the product of the tabulated number of wires per square inch and the net area of the slot after allowing for slot insulation and wedge. When the slot factor gets above .60 the winding begins to take more than normal time, getting real tough above .80. With a slot factor below .45 the winding eases substantially. If a winder alibis excess time on a job by complaining of a "tight" winding a check of slot factor will support or disprove his alibi.

Frame size and winding data 5 HP, 1800 RPM, 220 V, 3 phase,
60 cycle motors —

Make	Frame	D	L	D ² L	Slots	Turns	Size	Lbs.	Slot factor with HF
Dayton.....	225	5"	4"	100	36	22	1-15	14.4	.72
G. E.....	KT731	6	3 1/8	113	36	18	2-17	16.3	.53
L. A.....	OS43N	6	3 1/4	117	36	21	1-17	15.8	.66
							1-18		
G. E.....	K254-D	6 1/2	2 7/8	122	36	18	1-17	6.9	.59
G. E.....	K254	6	3 1/8	128	36	20	1-16	10.3	.54
G. E.....	KT936	6	3 5/8	131	36	36	1-17	14.6	.68
G. E.....	K254	6	3 3/4	135	36	22	1-16	14.2	.55
G. E.....	KT160	7	3	147	48	18	1-15	15.5	.43
Lincoln.....	DD254	6 3/8	3 5/8	147.5	36	20	1-15	14	.65
Howell.....	SC254	6 1/2	3 5/8	153	36	21	1-16	12.2	.50
Westinghouse.	CS	7 1/8	3 1/8	161	48	17	2-16	25.0	.66
Century.....	SC5	7	3 3/8	165	36	20	1-15	14.5	.48

Above are 2 circuit star except KT731 — 1 circuit delta, and KT936 — 2 circuit delta.

From a paper presented at
N.I.S.A. Convention
Tampa, Florida

Coil and Insulation Time

No. Groups	No. Poles	No. of Slots							
		24	36	48	54	60	72	90	96
6	2	.51	.65	.78					
12	4	.57	.71	.84	.90	.97	1.11	1.30	1.37
18	6	.62	.76	.89	.95	1.02	1.16	1.35	1.42
24	8	.68	.82	.95	1.01	1.08	1.22	1.41	1.48
30	10	.87	1.00	1.06	1.13	1.27	1.46	1.53	
36	12	.92	1.05	1.11	1.18	1.32	1.51	1.58	

For total coil and insulation time add .20 hr. to table times for single wire plus .15 for each additional wire in multiple, also add the following winding time:

$$\text{Hr.} = \frac{\text{Turns per coil} \times \text{number of coils}}{\text{Winding mach. RPM} \times 60}$$

The time for connecting can be set up in a similar manner. First, a fixed time getting lead wire and equipment ready for connecting. Estimated .20 hour.

Next, the variable time for connecting single wire single circuit which will vary directly as number of poles. Estimated .30 hour for 2 pole with 6 group ends. A 4 pole machine will have 12 group ends or .60 hrs., etc.

Finally, there will be an increase in variable time for each additional wire in parallel either as multiple wire coil or multiple circuits. A brief study indicated approximately 25 percent increase for each additional wire.

For example, a 4 pole single wire single circuit connection would consist of fixed time of .20 hr. plus a variable time of 2 x .3 hr. on .6 hr., making a total of .8 hr. If there were 2 wires in multiple and two circuits, the variable time would be increased by three steps of 25 percent each, or 1.17 hr., making the total 1.37 hr.

Once these basic time units are established a complete table can be made up as follows:

Three phase stator connecting time

Wires Times Circuits	NO POLES					
	2	4	6	8	10	12
1	.5	.8	1.1	1.4	1.7	2.0
2	.6	.9	1.3	1.7	2.1	2.4
3	.7	1.13	1.6	2.1	2.6	3.0
4	.8	1.37	2.0	2.6	3.1	3.7
5	.9	1.67	2.4	3.1	3.9	4.6
6	1.12	2.04	3.0	3.9	4.8	5.7
8	1.25	2.5	3.6	4.8	5.9	7.1
10	1.6	3.1	4.5	5.9	7.4	8.8
12	2.0	3.8	5.6	7.4	9.2	11.0

There still remain the operations of stripping, placing coils in slots and assembling and testing, all of which vary with the size of the frame, but in a manner that is difficult to express in a simple mathematical form. A study of this work is still going on and all that can be said at this time is that the total combined time in hours for these three operations comes very close to corresponding to the product of one-half of the air gap diameter and the square root of the core width. For example, on the three frames for which coil time was figured we would have the following total hours:

KT731

		Times in decimal hours not minutes
Coil and insulation time		.96
Connecting time 2 wires, 1 circuit		.95
Strip, wind & test time	$\frac{6}{2} \times \sqrt{3\frac{1}{8}} =$	5.31
Total		7.22 hours

K254-D

Coil and insulation time		.81
Connecting time 1 wire 2 circuit		.95
Strip, wind & test time	$\frac{6\frac{1}{2}}{2} \times \sqrt{2\frac{7}{8}} =$	5.51
Total		7.27 hours

CS

Coil and insulation time		1.17
Connecting time 2 wires 2 circuit		1.37
Strip, wind & test time	$\frac{7\frac{3}{8}}{2} \times \sqrt{3\frac{1}{8}} =$	6.35
Total		8.89 hours

The time values used in this discussion were based on some rather hurried overall time studies and need some re-checking for actual use.

The principal point to be brought out at this time is that a time study on this basis shows that if we can once establish the proper relationship between the time units or groups, we can boil down our time study of an apparently unlimited number of different jobs to a very few basic time elements. With these accurately determined the rest is a matter of simple arithmetic.

I am sure those interested in merit rating or incentive pay would appreciate a method that will allow taking your standard winding record card and right at your desk, with a few multiplications and additions, tell whether Bill or Joe is a good, medium or poor coil or stator winder. Also, for industry averages, instead of comparing hundreds of complete compilations of time rates we need only compare a limited number of basic time elements.

An examination of the above designs clearly shows enough variation to make horsepower and speed a poor basing

point for labor time studies. Since merit rating and incentive pay methods are getting front attention in industry today, there is a growing need for accurate time studies of the work performed in our shops. In this work we have a much more difficult problem than the manufacturer, owing to the continual changing character of the flow of work through our shops. In the manufacturing plant there is much repetition of identical jobs so it is practical and economical to make accurate studies of operations and set time standards. In our shops the usual detail time studies of the continually changing jobs is imprac-

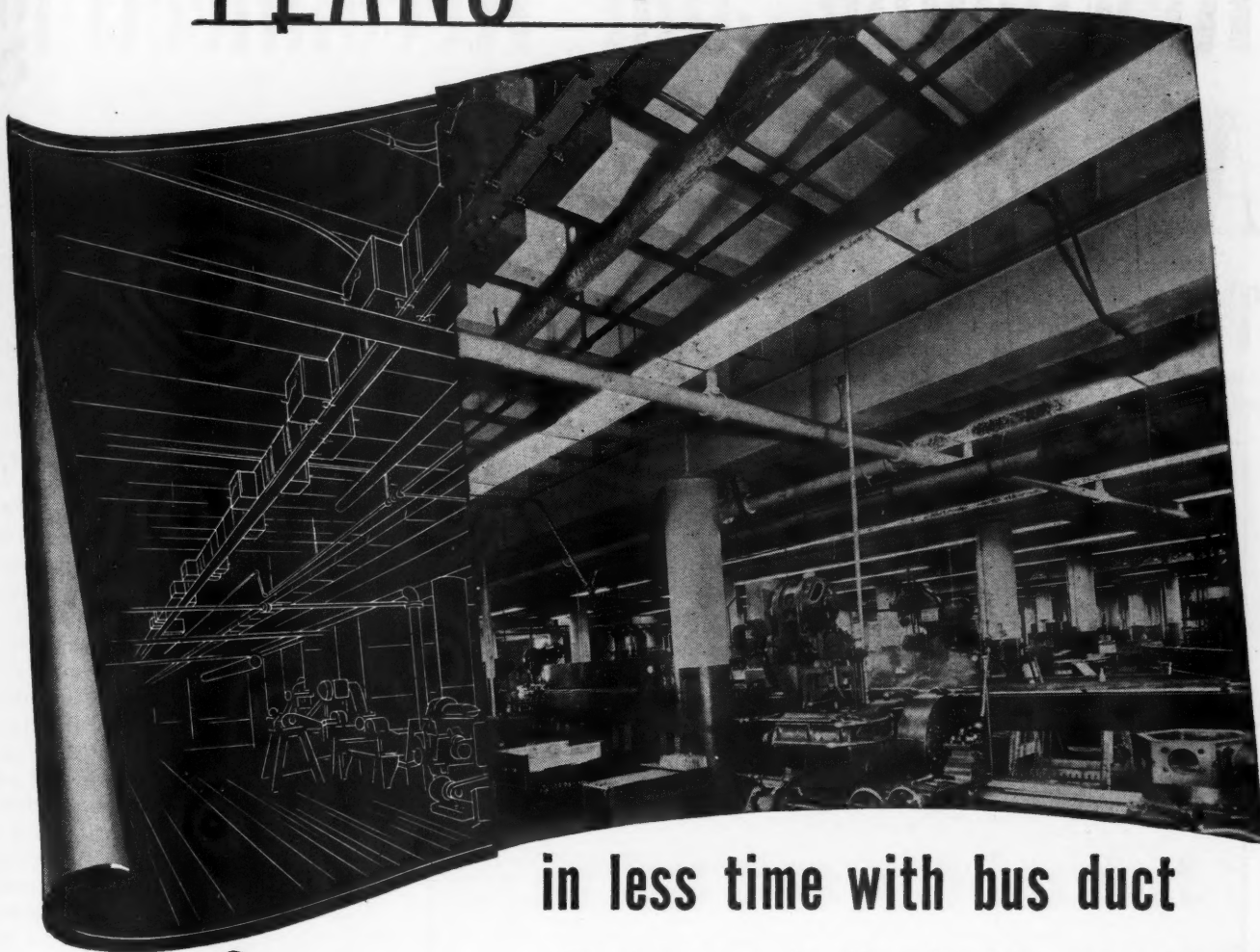
tical and expensive so some other means must be found.

One approach to the problem is to analyze our miscellaneous complete jobs to find a limited number of basic units of operating time, which can be measured and used as building blocks to build up the complete operation. From this standpoint, the following procedure is presented as a pattern to be followed in setting time standards in our shops, and, while this method cannot give us the accuracy of expert factory time study methods, it should at least approach actual conditions closer than our present broad average figures.

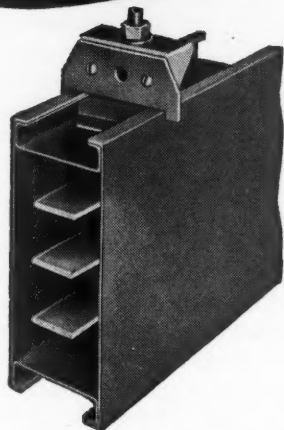
Taking the most common job of re-winding squirrel cage stators, we will start with the making of the coils and cutting insulation and see if we can develop a time rate based on the winding data and a few easily measured basic time units. All of the following discussion is confined to the winding of stators of the semi-closed slot construction, using group wound coils of heavy formvar magnet wire made on a modern group coil winder and without any

[Continued on page 113]

from PLANS to production



in less time with bus duct



Note strong, four-channel construction and cantilever hanger. Westinghouse Bus Duct is installed with wrench, screwdriver and block and tackle as the only tools.

Westinghouse
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

BUS DUCT



The old way was with cable and conduit . . . the new way is with bus duct. Bus duct puts the power where it's needed now and also where it may be needed in the future. Getting machinery into position . . . relocating machinery . . . or adding new machinery is simplified because there's a plug-in to power handy.

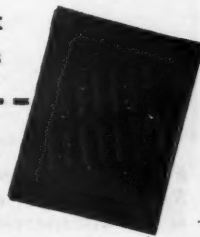
Exclusive features of Westinghouse Bus Duct include four-channel construction which makes it the strongest of all bus duct. Plug-in openings at 12-inch intervals, alternating from side to side. Plug-in points insulated with strong, high-dielectric Prestite, which also supports and insulates busbars. A cantilever hanger which slides to position, making it unnecessary to line up fixed hangers on duct with fixed supports overhead.

Westinghouse Bus Duct Engineers are at your service in working out the most efficient and economical secondary power distribution system for your plant with bus duct.

Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-60633

ASK YOUR WESTINGHOUSE DISTRIBUTOR, or write for your copy of Booklet B-3714. This new Bus Duct Data Book gives you complete information for fitting bus duct to the distribution job in your plant.



Rewinding and Reconnecting A-C Motors PART II

By
Rouel G. Cazanjan
Electrical Engineer
Brooklyn, N. Y.

THE first article in this series last month discussed the methods to use for connecting single phase motor windings for 3 phase operation together with a typical example of such a change-

over. Here we begin with the reverse condition, changing from 3 phase to single phase.

Three-phase to single-phase change.—It is sometimes required to change the

windings of a three-phase motor so as to make it operate in a location where the available power supply is single-phase.

The simplest method, next to purchasing a single phase motor if the mechanical features of the application will permit, is to reconnect the motor by identifying and separating the three phase windings and using any two as the running winding while the third is used as the starting winding. The two phase-windings may be connected in series or in parallel depending on which connection keeps the volts per turn within the permissible limits of plus or minus 10 percent on the new source of supply. It must be borne in mind that the proper voltage for two of the three 120 volt phase windings in series across three-phase is 208 and across single-phase is 240. The output of a three-phase motor is reduced to about 50 percent when reconnected to operate on single-phase. The efficiency, power factor, and the torque, are also reduced. The application of about 10 percent higher than rated voltage or cutting out the proper number of turns to bring about the same effect improve somewhat the characteristics of the single-phase motor.

In a split-phase single-phase motor, the ratio of the resistance of the starting winding to that of its main winding is not a definite quantity and depends on the inherent design features of the motor and the characteristics desired. On a number of motors of different manufacture which were designed for half to full load torque, the starting winding reactance was 0.5 to 0.8 times the main winding reactance. The foregoing method of reconnection automatically gives this desirable result. The ratio of the resistances of the reconnected motor is 1 to 2. The usual practice, however, is to have a starting winding resistance 1.6 to 3 times as large as that of the main winding. The required resistance can be added externally in the form of a coil wound resistor of the proper current rating. The resistance of one phase-

[Continued on page 182]

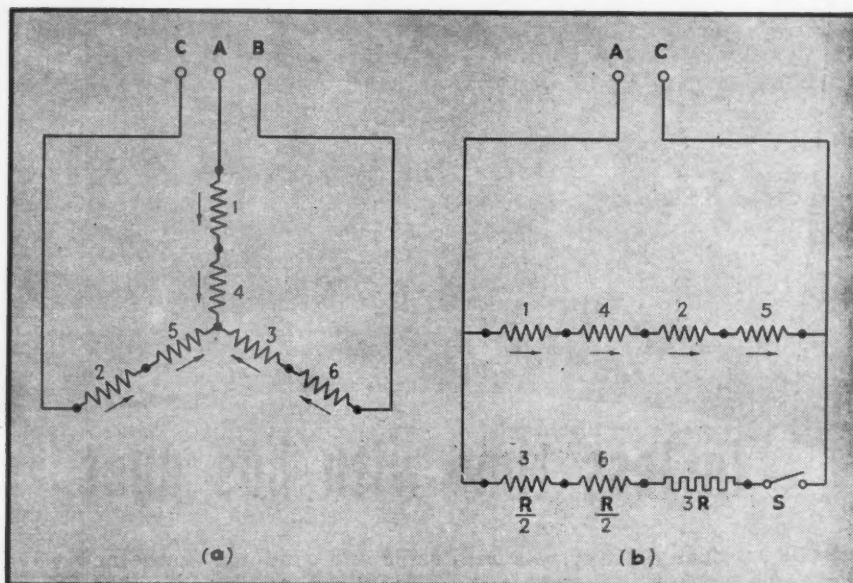


Fig. 3.—a) The six pole-phase groups of a 2-pole, three-phase motor. b) Pole-phase groups of Fig. 3a reconnected with single-phase operations. The resistor must have an ohmic value three times that of the phase-winding. S may be a manual or centrifugal switch.

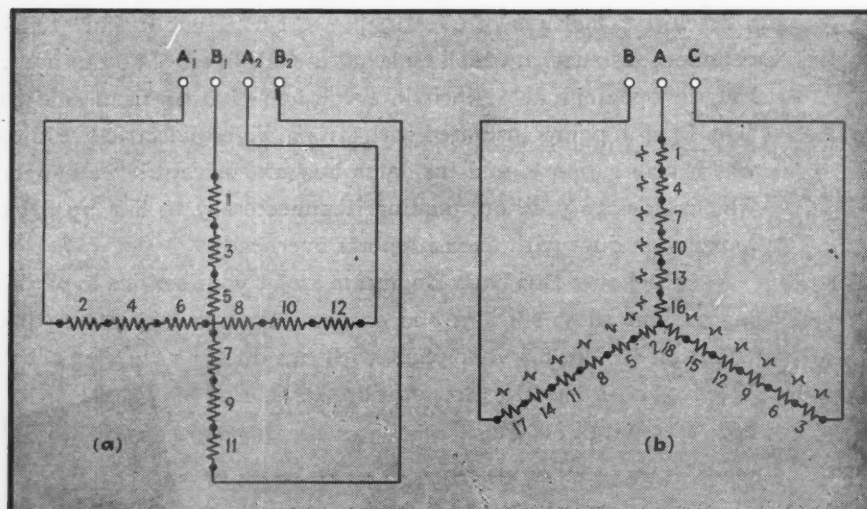


Fig. 4.—a) Pole-phase groups of a 6-pole, 72 coil, two-phase motor. Connection: Series. b) Stator core of Fig. 4a rearranged for three-phase operation. One coil is left disconnected from each group. Connection: Series-star.

*Newest member
of the Hazard
Building Wire Family...*

Hazard PERMEX Building Wire Type RU

Insulated with rubber Latex and covered with a protective Dilec fibrous sheath, PERMEX offers you a new small diameter building wire fully approved by 1946 NEC for new wiring and rewiring



Here are the quick facts about this latest of Hazard Building Wires to help you make adequate wiring a reality in your new construction jobs or remodeling contracts.

Hazard PERMEX offers:

1. The smallest diameter building wire . . . saves conduit space, leaves room for expansion.
2. 90% unmilled grainless rubber insulation.
3. Exceptional mechanical strength and elasticity.
4. High dielectric strength and insulation resistance.
5. Up to 60 degree C. operating copper temperature.
6. Weather-proof, flame-resistant Dilec fibrous covering.
7. Smooth lubricated finish for easy pulling . . . comes in standard building wire colors.
8. Full approval under 1946 National Electrical Code as type RU for both new wiring and rewiring.

For further information get in touch with your nearest Hazard representative or write The Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

HAZARD

insulated wires and cables for every electrical use

CENTRAL RIGID STEEL CONDUIT MEANS DEPENDABILITY LONG LIFE



SPANG-CHALFANT

Division of The National Supply Company

General Sales Office: Grant Building, Pittsburgh 30, Pa.

District Offices and Sales Representatives in Principal Cities

PRACTICAL METHODS

TERMINAL SOLDERING JIG

WIRING

The process of soldering conductors into terminal lugs is aided by the use of a jig designed by J. Panella, an employee of the Marinship Corporation of Sausalito, California.

Prior to using the jig it was the customary practice to fill terminals with solder and shove these lugs over cable ends. The cable was held in a bench vise, the lug was held by a pair of pliers in one of the worker's hands and a torch, for maintaining the solder in a liquid state, was held in the operator's other hand. With this arrangement it was difficult to either make a good connection or to operate with any degree of speed. Excess solder was forced out of the terminal during the process and fell to the floor as wasted material. Although the amount of waste material was small in each instance, the quantity became a positive item when multiplied by thousands of operations. The method proved slow, mechanically inefficient and uneconomical.

The terminal soldering jig, now used in this shipyard, is simple in design, promotes sturdy connections and salvages all surplus solder for reuse. A round 12-inch steel pan with a 2-inch vertical lip is centrally drilled to accommodate a 4-inch section of 1-inch pipe which is braised to the pan as illustrated in sketch A. A converted welding stinger is attached to a rolled steel extension rod which passes through the collar of the 1-inch pipe and extends 3-inches below the pan. A hole bored in the work bench receives this extension rod, anchors the assembly in a fixed position and prevents sliding or upsetting. The stinger is used as a vise to hold the lugs while solder is being poured and the spring handle makes it possible to rapidly grasp or release the lugs. A slotted section of 1-inch flexible tubing is held directly over the jaws of the stinger by an open S-curved bracket rising from the pan rim.

In operation, water is poured into the pan to a depth of about an inch, a lug is placed between the stinger jaws, solder is poured into the terminal cavity, the cable is passed downwards through

the overhead guiding tube, the terminal is heated with a blow torch, the cable end inserted in the solder and the joint wiped with a wet rag to quicken solidification. Excess solder, forced from the terminal, drops to the water-filled pan where it is quenched and later salvaged for reuse. Large terminals can be withdrawn through the guiding tube by slightly springing the flexible collar.

The cost to construct each jig is less than \$2 and, in a shipyard the size of Marinship's, the time saved through its use exceeds 200 hours a month.

The double angle iron assembly (sketch E) is held together by two bolts which run through both angles and a spacing nipple. Lugs are held ready in an upright position by inserting the terminal tongues between the faces of the angles.

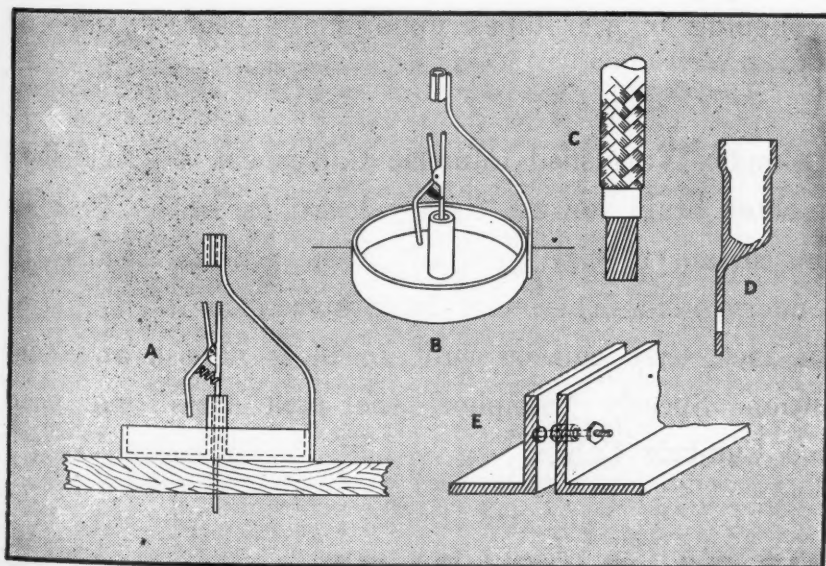
OVEN RE-DESIGN BOOSTS BRUSH OUTPUT

INDUSTRIAL

Increasing plant productivity without exceeding the limitations of an existing, crowded floor area was the problem of the Maendler Brush Manufacturing Company, Inc. of St. Paul, Minnesota, when war-necessitated government orders stepped up the demand for their paint brushes. Oven capacity was the bottleneck in their production cycle, inasmuch as bulky, slow-heating, reel type bakery units were being employed for vulcanizing the set-in-rubber brushes.

To increase plant capacity and output, an engineering survey dictated the necessity for a more compact heating unit with a more efficient distribution and circulating system, controlled for sustained heat uniformity and automatically timed for cut-off as protection against power, fan or gas failure.

Rough specifications were referred to the Despatch Oven Company of Minneapolis, Minnesota, and it was recommended that 1800-pound capacity drawer-type units be installed. A single unit was placed in service on an experimental basis and a 250 percent increase in pro-



A converted welding stinger holds cable terminal lugs (D) in a vertical position while the skinned cable (C) is passed downwards through a flexible guide tube. The base of the assembly (A—Plan; B—Perspective) is a metal pan which, when water-filled during terminal soldering operations, catches and salvages surplus solder. A double angle iron assembly (E) holds lugs in an upright, quickly grasped position.



USE SIMPLEX VARNISHED CAMBRIC CABLES FOR PERMANENT RECONVERSION

When you install Simplex Varnished Cambric Insulated Cables in your customer's plant you are reducing your cable troubles to a minimum. Simplex Varnished Cambric Cables are not spectacular in their operation. Rather, they are the work horses of industry. They go along minding their own business, working all day long, dependably, and without giving trouble.

The cambric tapes used to make Simplex Varnished Cambric Cables are protected with many layers of insulating varnish on each side of the fabric. As these tapes are wound on the conductor, a non-migrating compound is used to allow for the slipping of the tapes upon one another when the cable is bent.

Simplex Varnished Cambric Cables can be furnished with an outer braid for use in dry locations, with a rubber jacket in certain special uses and with a lead sheath for burial underground. They can be protected with flat steel tapes. In fact, they can be built to meet almost any sort of condition. Specify "Simplex" the next time you need Varnished Cambric Cables.

Simplex

WIRES & CABLES

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.



Drawer-type oven with overhead mechanism, forced exhaust, regulated temperatures and numerous safety features increased brush vulcanizing capacity 250 percent over output of previously-used reel bakery unit.

duction was experienced with the result that additional units since have been added.

With the same floor area formerly occupied by the reel units, the drawer type oven has $2\frac{1}{2}$ times the brush capacity. An overhead loading mechanism permits the withdrawal of either a single or several drawers at one time for recharging. Automatic controls regulate the temperature within a $2\frac{1}{2}$ -degree limit through a heat range from 125 to 250 degrees F., record graphically the heating cycle and automatically shut off the unit when any production failure occurs or when a predetermined time interval has been completed. Rockwool insulation and a high capacity forced exhaust system, carrying heat and odors to the exterior of the building, maintain excellent working conditions within the plant.

WIRING OFFICE BUILDINGS

WIRING

Statistics, based on pre-war tabulations compiled by the Census Bureau and various trade groups, indicate that there were more than 18,000 office buildings in the country in 1939 containing over 300,000 individual office establishments. With business enterprises being established and re-established daily, office space is at a premium and all sections of the country are reporting new office construction, extensive alterations and modernization either in progress, in the design stage or contemplated for the near future when materials, conditions and regulations permit.

The prewar impetus in planned lighting and adequate wiring was gaining momentum in this field when the national emergency diverted the major portion of available material to industrialized war plants. While the standards for adequate wiring and lighting steadily mounted, conditions prevented commercial and general business firms from keeping pace with the trend and it is conceded that the potential electrical market with this type of occupancy is now strengthened through education, desire, demand and necessity. Requests for practical distribution systems, wiring layouts and planned lighting are resulting in orders and profit for those contractors who have constructive answers to these problems.

Cut and dried rules cannot be presented for any general field of wiring; particularly for buildings where the occupancy varies as widely as in office structures. Requirements will differ for lobbies, elevator hallways, corridors, reception rooms, clerical space, libraries, board rooms, drafting rooms, lavatories and exteriors. Many office buildings contain barber shops, restaurants, auditoriums, photographic studios, tailoring and general merchandising shops. Wiring must be sufficiently flexible and of a capacity ample for a reasonable variety of demands. Present standards dictate an average installed capacity of at least 5 watts per square foot and there is little assurance that this standard will not be exceeded. The minimum sized conductor should be a No. 12 wire. Thought should be given to sufficient convenience outlets for office equipment. Those contractors planning lighting

systems should be familiar with the results obtainable through combinations of direct and indirect incandescent and fluorescent units (*Electrical Contracting* "Relight America" section in the April issue) and should consider lighting in relation to color treatments, architectural design and tenant requirements. Lighting intensities should be selected from a safety and comfort angle as well as utility. Momentary blindness could result if walking from a 100-foot-candle drafting room directly into a 10-foot-candle hallway and eye-fatiguing strain could accompany high light levels when thought has not been given to source brightness and glare.

Thin-walled synthetic cable insulations should be remembered for increasing electrical capacities in existing conduits. Main feeders and distribution panels should be placed as closely as possible to the center of the loads and protective devices should be included for all circuits and major pieces of equipment.

Not as an inclusive panacea but as a suggestive stimulus for constructive thought, the accompanying check list is presented for contractors bidding for their proportionate share of the estimated national annual commercial electrical market of 250 million dollars.

TURNBUCKLES GOVERN REEL FRICTION

WIRING

A simple method for maintaining regulated tension on large diameter wires

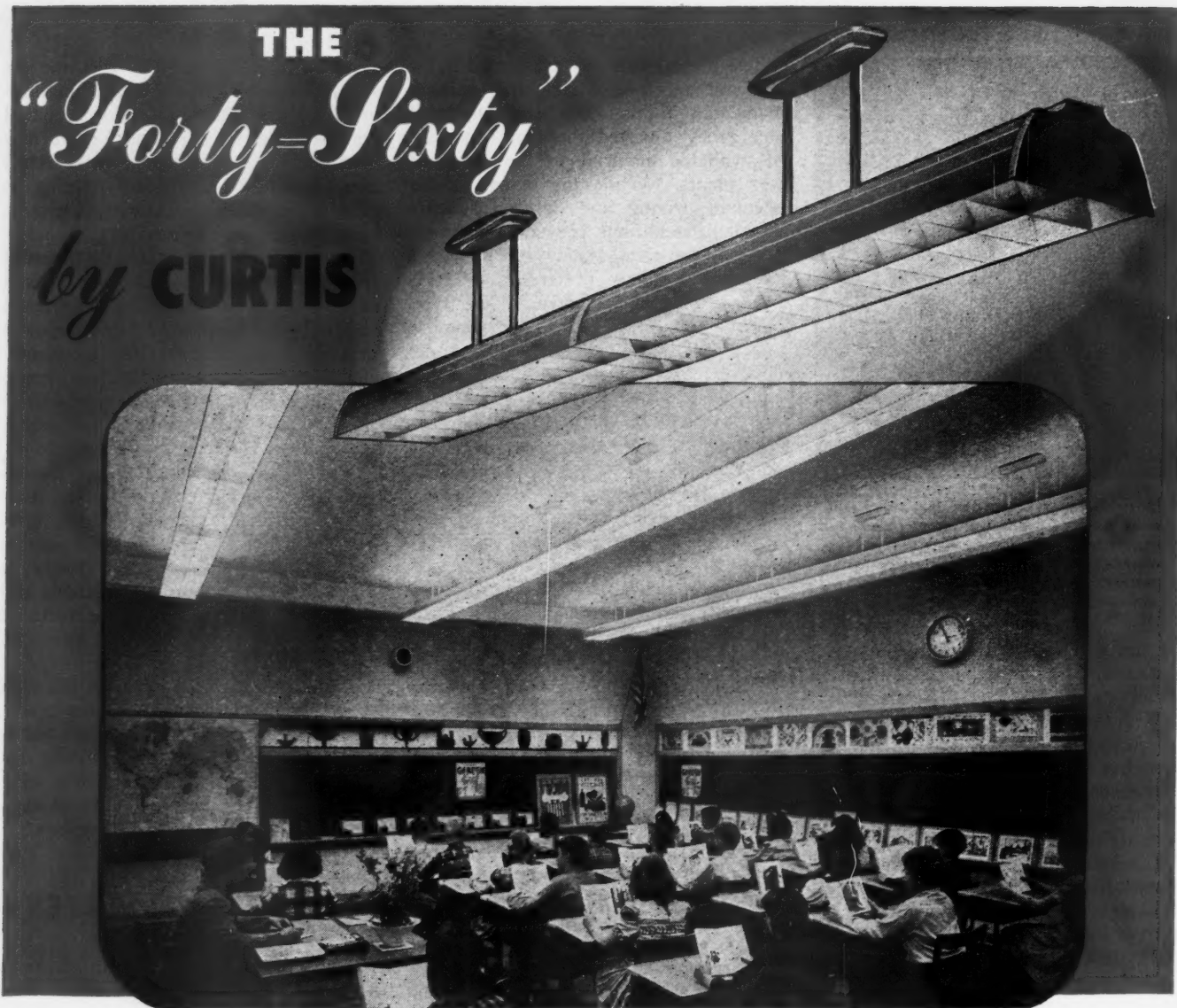
WIRING CHECK LIST FOR OFFICE BUILDINGS AND OFFICES

Addressographs	Electric hand dryers	Pumps—sump, vacuum
Adding Machines	Elevators	Refrigeration
Air tempering apparatus	Envelope sealers	Repair shop equipment
Air washers	Fans—ventilating, exhaust	Rotary drilling apparatus
Annunciator systems	Flood-lights	Signal systems
Ash hoists	Floor scrubbers, waxers, polishers	Signs—exit, elevator, lavatory
Banks	Heaters	Soldering irons and pots
Battery charging sets	Heating plant	Tabulating machines
Bell ringing transformers	Hoists—sidewalk	Telautographs
Calculating machines	Hot water heaters	Telephones
Cash registers	Letter copying presses	Thermostats
Cigar lighters	Letter folders and openers	Ticket stampers
Clock systems	Money counting machines	Time stamps
Controls—heating	Multigraph	Vacuum cleaners
Conveyors	Oil heating apparatus	Water filters
Compressors	Portable electric hoists	Water sterilizers
Coupon clippers	Printing machines	Window washers
Dictaphones	Printing presses	
Duplicators		

Recommended levels of Illumination

Lobbies, elevator halls, corridors	5—10 footcandles
Reception and conference rooms, auditoriums, stockrooms, lavatories, restaurants	10—20
Casual desk work, libraries, filing	15—35
Bookkeeping, accounting, stenographic, critical desk work, merchandising	35—70
Drafting, business machines, displays, proof-reading	75—100

THE "Forty-Sixty" by CURTIS



MODERN LIGHTING FOR TODAY'S CLASSROOMS

Curtis "Forty-Sixty" is the ideal fluorescent lighting unit for lighting the average school classroom. You can safely specify it either for relighting or new construction.

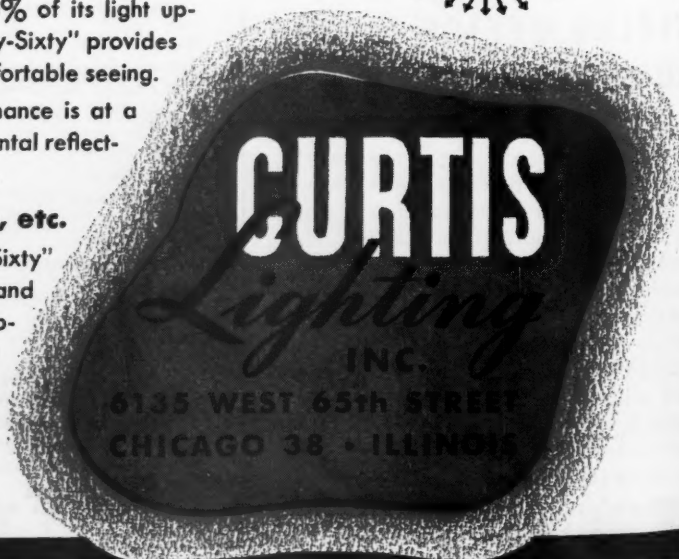
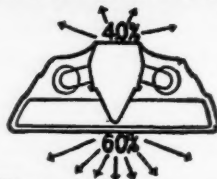
Designed to direct about 40% of its light upward and 60% downward, "Forty-Sixty" provides balanced lighting for efficient, comfortable seeing.

Made of Alzak Aluminum, maintenance is at a minimum because of the lack of horizontal reflecting and diffusing surfaces to collect dust.

Also for Offices, Drafting Rooms, etc.

The same characteristics that make "Forty-Sixty" ideal for classrooms, recommend it for office and drafting room lighting. Fixture brightness is exceptionally low and the indirect (upward) component of light helps to hold brightness contrasts within comfortable limits.

Easily installed either in continuous lines as illustrated above or as individual luminaires. Write for complete technical data today.





Heavy wires passing over grooved reel rims are connected to coiled springs by means of adjustable turnbuckles. The reel, revolving around a horizontal spindle resting in notched wooden side frames, is prevented from freely turning due to tension regulated by the turnbuckles. Guy wires prevent the frame from sliding.

leaving reels for winding frames is indicated in the accompanying illustration. The reel revolves around a horizontal 1-inch round steel bar resting in notches in the sides of a heavy wooden frame. When reels are less than three feet in diameter the steel spindle is placed in these timber crotches. When larger reels are used the spindles are passed through holes drilled in the timber framework at twice the height of the notch level.

To prevent the reel from freely turning and to maintain desired tension on the unreeling wires, heavy wires are fastened to the front of the frame base and passed around the upper semi-diameters of the grooved reel rims. Heavy coiled springs are fastened to the rear of the frame base and the springs and heavy encircling wires are connected by means of turnbuckles which may be adjusted to give the proper tension.

When coil winders draw wire from the reels, the friction-retarded reels have the normal tendency to slide towards the winders. This tendency is checked through the use of guy wires running from the top of the frame side arms to bolts in the flooring. This arrangement is used in the coil winding shop of the Everson Electric Company, Allentown, Pa.

The method is employed only when all other tension devices are otherwise in use but the practice has given excellent results. Construction is simple, suggesting ready duplication.

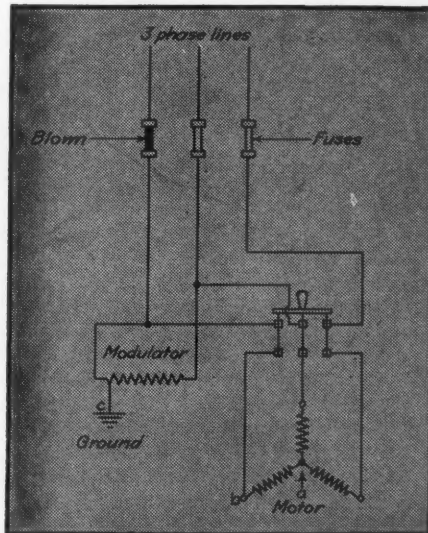
MULTIPLE PROBLEMS IN HEATING PLANT MAINTENANCE

MAINTENANCE

The Maintenance Company, Inc., of New York City reported an interesting combination of compensating faults which were encountered last winter while answering an emergency call from the agent of a large apartment building. A three-phase motor, directly connected to a combination blower and oil pump, was running unusually hot and, with temperatures in the freezing zone, it was imperative that immediate steps be taken to insure continuity of heating service.

An examination of the dirty and oil-soaked motor revealed severely scorched insulation and a partial short circuit. Tests also indicated that the motor had been operating with one of the three fuses blown. There arose the natural question of how the motor started since it is a known fact that a three-phase motor will not start on single phase (two fuses). Once started, a three-phase motor could operate on single phase but the current is ordinarily excessive, burning the windings.

The question was answered by locating a ground existing in a modulation controller used to regulate the heating plant's damper, connected to the same circuit as the blower motor. Two possible solutions were apparent. If the ground blew the fuse after the motor started, the motor would or could have continued running on single phase. If, however, the fuse had been blown before the motor started, enough current could



Three-phase motor, connected to lines containing a blown fuse, continues to operate due to grounded condition of modulator in same circuit. Current passes from "a" through "b" to "c" and starting winding is energized.

have passed through the third motor winding to ground sufficiently out of phase with the single phase current to cause the third winding to act as a starting winding. This starting current (referring to the illustration) would pass from point "a" through the third winding to "b" and then to the ground at "c".

To reduce the shut-down period, a spare motor was required and, since a motor of identical frame-size was not available, it was decided to belt the spare to the blower by means of a V-belt. Two iron bars were bolted to the blower base to hold the spare motor and the flange coupling was removed from the blower shaft. But again the unexpected was encountered on finding the flange coupling threaded and screwed on the blower shaft. A special adapter was made in the shop to adapt the V-groove pulley to the blower shaft and the change was completed satisfactorily without subjecting the tenants to the inconvenience of a prolonged heating lag.



A symposium on "Lighting of Small Airports" was a feature of the IES East Central Regional Conference, Philadelphia, Pa., held the first part of this year. Taking part in this symposium were (l. to r.—seated) A. A. Fox, Civilian Production Administration, who presented the background for the discussions; C. R. Seybold and L. C. Vipond, Civil Aeronautics Administration, who made the main presentation; (l. to r.—standing) F. C. Breckenridge, National Bureau of Standards who gave the scientific aspects; Lt. M. A. Warshaw, U. S. Navy, and Lt. Col. J. P. Huebsch, U. S. Army, who presented the military aspects; and J. F. Angier, Civil Aeronautics Administration, who discussed the civil and international aspects of the subject. All are from Washington, D. C., and active members of the Capital Section of the Illuminating Engineering Society.



To the man who *PULLS* Rubber Covered Wires

Why Skin Wires?

... Get a Grip!

KELLEMS COMPANY

Saugatuck, Conn.

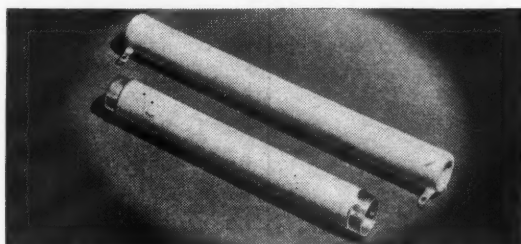


THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of **ELECTRICAL CONTRACTING** you saw the item and they will send full details to you.

EQUIPMENT NEWS

Resistors

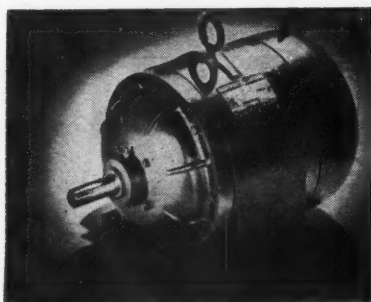
The addition of Vitrohm "M" Vitreous Enameled resistors to this standard line has been announced. Meeting all the requirements of U. S. Army-Navy specification JAN-R-26 for Characteristic "F", these resistors are designed for use on power type resistor applications where severe operating conditions are encountered. These Grade 1, Class I resistors are available in ferrule, tab and screw terminal types with power ratings from 8 to 155 watts and capable of operation continuously at 275°C it is claimed. Resistance values are obtainable in sizes covered by the specification, ranging from .1 to 80,000 ohms with resistance tolerances for one ohm and above of plus or minus 5 percent specified values. Ward Leonard Electric Co., Mount Vernon, N. Y.



WARD LEONARD RESISTOR

Motor

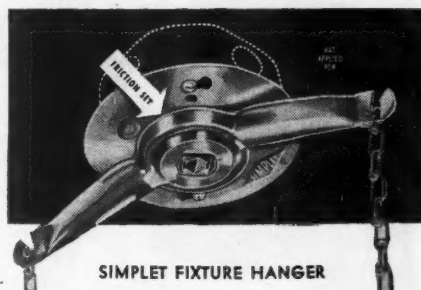
A new totally enclosed, fan-cooled motor designed for use in dusty, dirty and corrosive atmospheres has been added to this line of Tri-Clad induction motors. It is available in standard, explosion-proof, and dust-explosion-proof types from 1 to 1,000 hp. and can be used where iron dust and metal fillings are in the air and in Class I Groups C and D and Class II Groups E, F and G hazardous locations. Short in length, the motor can be installed in a small space, making it suitable for machine tool applications where the motor must be part of the driven machine. It features a double-shell, cast iron frame, and cast iron end shields and conduit box. Punchings and windings within the inner shell of the motor are cooled by a non-sparking external fan which is protected by a cast iron housing with a screened air-intake opening. General Electric Company, Schenectady, N. Y.



G-E TRI-CLAD MOTOR

Fixture Hanger

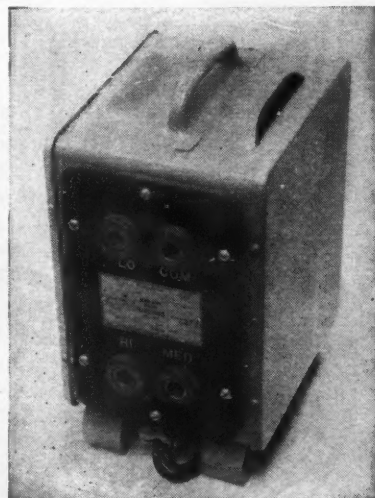
The new "Friction Set" fixture hanger may be hung in any position, as it has 360° adjustment and may be turned to any angle after being screwed to outlet box. Base and receptacle remain stationary, but hanger arms may be turned to align with any preconceived lighting plan. Fixture ring holds unit in selected position. The hangers screw to either 3½ inch or 4 inch outlet boxes. Overall depth of box used is 7/16 inch. It is made of steel, with cadmium finish. Diameter of cover is 4-11/16 inch, overall length of arms is 9 inches. Hanger is furnished with 15 amp. receptacle, two 5-ft. chains, hooks and cord clips. Simplet Electric Co., 123 N. Sangamon St., Chicago 7, Ill.



SIMPLET FIXTURE HANGER

Portable Brazier

For making lap joints in copper strap, attaching terminals to cable, brazing coil ends and general copper smithing work, a new portable 5 kva. brazier has been announced. The brazier, which requires connection to a 220 volt source, consists of a transformer, voltage selectors, controls, and carbon-tipped tongs. Alternating current from an adjustable voltage transformer passes through the tongs and parts to be brazed, raising the temperature to a point at which the brazing alloy melts. The alloy may be applied in the form of a rod or ribbon. Three outlets are provided on the control panel for 8, 6 or 4 volts. A foot switch with pilot cable serves as the primary control switch. Westinghouse Electric Corporation, Pittsburgh 30, Pa.



WESTINGHOUSE BRAZIER

**FOR BETTER FUSIBLE
PANELBOARD JOBS!**
Yours For The Asking!

WURDACK

**FUSIBLE
PANELBOARDS**

WM. WURDACK ELECTRIC MFG. CO.
444 CLAYTON AVENUE
SAINT LOUIS 10, MO.

Send for your copy!

WWW.WURDACKELECTRICMFG.CO

Thinline Fluorescent Lamp Ballasts

Two new thinline fluorescent lamp ballasts designed for the operation of the new long, thin, hot cathode fluorescent lamps have been announced. These transformers are small light-weight units that incorporate the Sola constant voltage principle. Wide line voltage variations do not affect this new transformer, assuring constant light output from the lamps, instant starting and long lamp life. They are listed by the Underwriters Laboratories. Sola Electric Company, 2525 Clybourn Ave., Chicago 14, Ill.



SOLA BALLAST

Weatherproof Socket

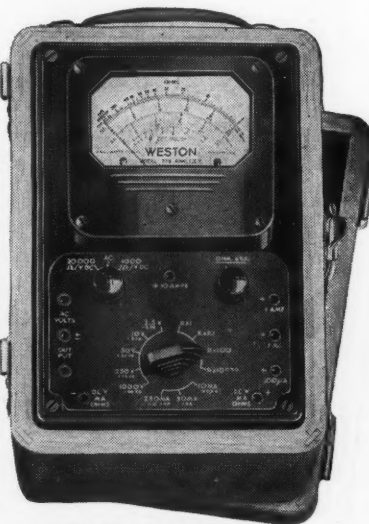
A new weatherproof socket made of bakelite compound has been announced. It is equipped with leads of No. 14 Type R wire, single conductor, stranded and tinned, with ends stripped one inch for easy connection. The space around the lead-in wires where they enter the socket body, as well as the space between the screw-shell and the socket body, is filled with heat resisting wax. Eagle Electric Mfg. Co., 2310 Bridge Plaza South, Long Island City 1, N. Y.



EAGLE SOCKET

Analyzer

A new precision-built super-sensitive analyzer, Model 779, has been announced. It measures $6\frac{1}{2}$ in. by $9\frac{1}{8}$ in. by $4\frac{7}{8}$ in. and has five overlapping a-c and d-c voltage ranges, seven d-c current ranges, four d-c resistance ranges, and five decibel ranges. Each range has been selected for adaptability to all requirements of electronic testing and maintenance. Each d-c voltage range is available at a dual sensitivity of 1,000 or 20,000 ohms per volt. This unit is recommended for field maintenance or shop testing of all types of commercial or industrial electronic equipment. The 20,000 ohm per volt d-c sensitivity is particularly suited to the measurement of potentials in the high resistance circuits encountered in electronic receivers, transmitters, communications equipment, cathode ray units, electronic timers, and machinery controls, dielectric heating units and all other associated electronic devices. Weston Electrical Instrument Corporation, Newark, N. J.



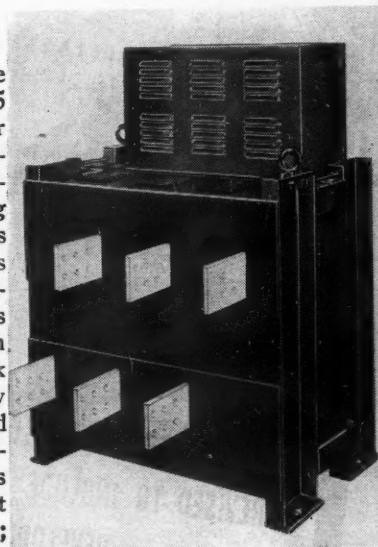
WESTON ANALYZER

Tape

This new kind of tape, called Cohrlastic, is made by coating Fiberglas with Silastic. The new tape has many applications in the electrical field on account of its high dielectric properties—1100 volts per mil—and extraordinary capacity to retain this strength at temperatures up to 500° F and not breakdown and carbonize. It is resistant to arcing and corona cutting, waterproof and water repellent. Cohrlastic is not sticky and wraps are bound at the ends. Connecticut Hard Rubber Company, New Haven, Conn.

Transformers

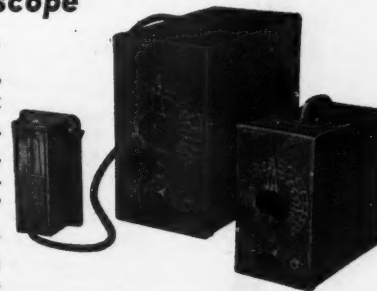
A new, improved line of transformers from 5 to 500 kva, suitable for electric furnaces, resistance heating and welding, rectifiers, testing and other applications where heavy current is required has been announced. Transformers include a built in switch with safety interlock for changing secondary voltages; new method of ventilation; protection of vital parts against corrosive, dust laden atmosphere; heavy current winding laminated and transposed to reduce eddy current losses; the use of heatproof insulation. Available for any line voltage and frequency, also 3 phase primary, 3 phase secondary; 3 phase primary, 2 phase secondary; and single phase. Marcus Transformer Co., Inc., 32 Montgomery Street, Hillside 5, N. J.



MARCUS TRANSFORMERS

Portable Stroboscope

Model 1210, a newly developed stroboscope, employs a novel circuit arrangement, using a self-blocking oscillator. Rotary or vibratory motion can be "stopped" when the moving object is examined with stroboscopic light source. The speed covered is from 600 to 48,000 rpm. (10-800 cycles per second), in 4 ranges. A synchronized reed is provided for accurate calibration against the line frequency. All four scales can be calibrated within three percent. It is also useful for studying mechanical stresses and strains under dynamic conditions and determining their speed or rate. The light source is contained in a probe attached to a four foot flexible cable. Communication Measurements Laboratory, 120 Greenwich Street, New York 6, N. Y.



CML STROBOSCOPE

NAME OF MANUFACTURER

**COMPLIANCE WITH
SPECIFICATIONS UNDER
PROVED INSPECTION
PROCEDURE OF RLM STANDARDS
INSTITUTE CERTIFIED BY
ELECTRICAL TESTING
LABORATORIES, INC.**

**RLM STANDARD
SPECIFICATIONS**

**for
RLM 48" FLUORESCENT TWO-LAMP
OPEN END PORCELAIN ENAMEL UNIT**
★ WITH MEDIUM LAMP SOAKING ★

The Letters RLM signify Reflector and Lighting Equipment Manufacturers

307 N. MICHIGAN AVE.
CHICAGO 1, ILL.
THE CERTIFICATE OF
QUALITY

**RLM SPECIFICATIONS COMPLETELY
REVISED TO INCLUDE LATEST TECHNICAL
DEVELOPMENTS**

- No.
100 Testing and Inspection Procedure
- 1 RLM Dome Reflectors
 - 2 RLM Deep Bowl Reflectors
 - 3 RLM Symmetrical Angle Reflectors
 - 5 RLM 48" Fluorescent Two-lamp Closed end porcelain enamel unit
 - 6 RLM 48" Fluorescent Three-lamp Closed end porcelain enamel unit
 - 7 RLM 60" Fluorescent Two-lamp Closed end porcelain enamel unit
 - 8 RLM 60" Fluorescent Two-lamp Closed end porcelain enamel diffuser unit
 - 9 RLM 48" Fluorescent Two-lamp open end porcelain enamel unit
 - 9A RLM 48" Fluorescent Two-lamp open end porcelain enamel unit
 - 10 RLM 48" Fluorescent Three-lamp open end porcelain enamel unit
 - 11 RLM 60" Fluorescent Two-lamp open end porcelain enamel unit
 - 12 RLM 60" Fluorescent Two-lamp open end porcelain enamel diffuser unit
 - 18 RLM Glassteel Diffusers
 - 22 RLM Fluorescent Two-lamp closed end porcelain enamel unit
 - 23 RLM Fluorescent Two-lamp open end porcelain enamel unit

**Practical Guides for Men
who buy or sell INDUSTRIAL
LIGHTING EQUIPMENT**

When making plans for industrial lighting to take advantage of the latest developments in illumination engineering, play safe by specifying industrial lighting units built to conform to up-to-the-minute RLM specifications and identified by the RLM LABEL.

Every industrial lighting unit qualified to bear the RLM LABEL must conform to rigid RLM Official Standard Specifications that cover construction and performance factors vital to safety, lighting efficiency and economy. That is why it is so worthwhile to follow RLM Specifications in specifying, and to look for the RLM LABEL when buying Incandescent and Fluorescent industrial lighting equipment.

Copies of all the latest RLM Specifications, listed at left, may be secured through any manufacturer using RLM inspection and certification service, or direct from RLM Standards Institute.

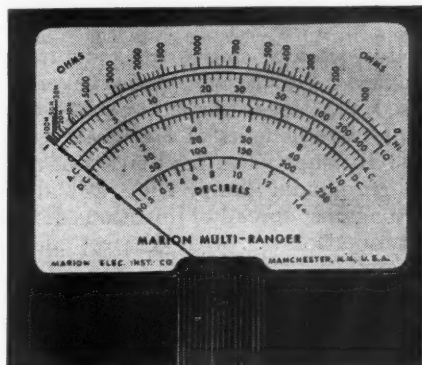
The Letters RLM Stand for Reflector and Lighting Equipment Manufacturers

RLM STANDARDS INSTITUTE
INCORPORATED

307 N. MICHIGAN AVE. • SUITE 420 • CHICAGO 1, ILLINOIS

Instrument

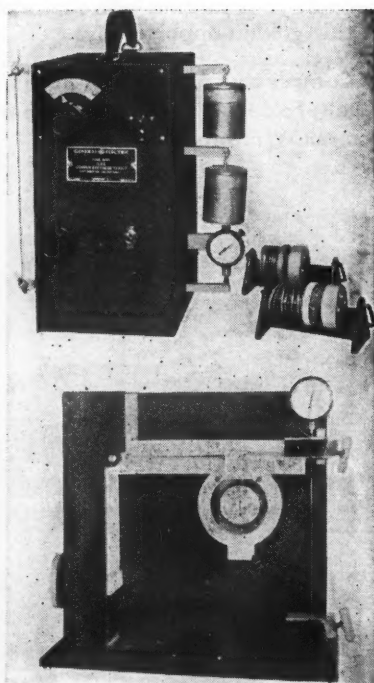
A new foundation instrument, called the Multi-Ranger, designed to permit the user to assemble a highly accurate instrument for use as a voltmeter, milliammeter, high and low resistance ohmmeter, a-c voltmeter and decibel meter, has been announced. They are available in 3½, 4½ and 8½ inch sizes and each size is interchangeable electrically. The basic sensitivity of the instrument is 400 microamperes and the internal resistance is 500 ohms, plus or minus one percent. The scales are printed in three colors for quick identification. The instrument is suitable for use as a 2500 ohm-per-volt or as a 1000 ohm-per-volt a-c voltmeter. Marion Electrical Instrument Company, Manchester, N. H.



MARION MULTI-RANGER

Elongation Testers

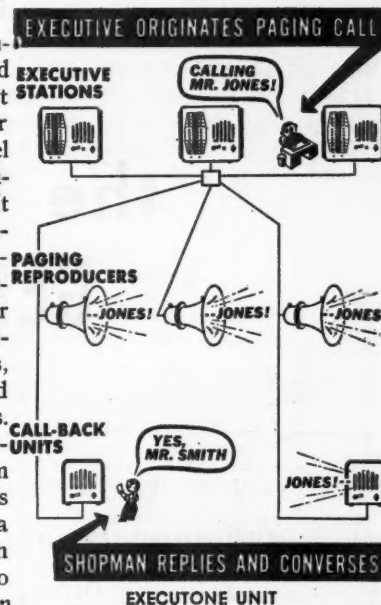
Two new low stress elongation testers for measuring the stiffness, or springiness, of large and fine copper wire have been announced. The large wire tester measures elongation of wire from 17.9 to 80.8 mils in diameter, and the portable fine-wire instrument tests wire from 3.1 to 17.9 mils in diameter. When the large wire tester is used, the wire is stretched between two clamps, one stationary and one movable, and a unit stress of 15,000 lb. sq. in. is applied by a jack-screw-operated lever arm. Elongation is recorded on a large micrometer dial. When using the fine-wire tester, the wire is clamped between vises located on the ends of two movable arms and stress is applied by means of weights which are furnished with the equipment. Adjustments are made with dials on face of instrument. General Electric Company, Schenectady, N. Y.



G-E ELONGATION TESTERS

Call-Back Unit

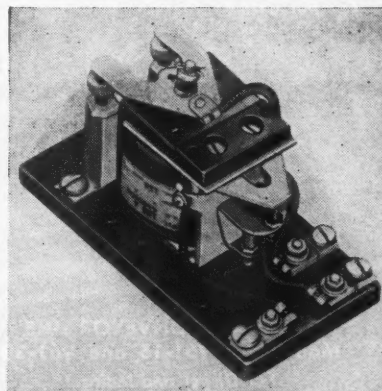
Model C-18 is a combined call-back and sound reproducer unit designed especially for use with high noise level coverage industrial communication systems. It is used with combination intercom and amplified voice-paging systems having any number of fully intercommunicating master stations, trumpet speakers, and other stand reproducers. In operation, any person having an intercom master station on his desk can originate a paging call in addition to having regular two way intercommunication



with all other master stations. To page, he depresses the paging button and calls by name the person he wishes to locate and speak to. The person paged approaches a call-back reproducer station, depresses the key and automatically is connected directly to the executive who originated the paging call. All other amplified reproducers and call-back units are automatically silenced while the two-way conversation is in progress. The unit is 7¼ inches high, 6½ inches wide and 5½ inches deep. Executone, Inc., 415 Lexington Ave., New York 17, N. Y.

Relays

Bulletin 130 relays are designed for heavy duty industrial and electronic applications such as light contactor duty, control of single phase motors and other remote or automatic control purposes. Contact arrangements are available from one to four poles, normally open or normally closed, single or double throw. Operating voltages for d-c relays are from 6 to 230 volts and for a-c from 6 to 440 volts. Relay contact ratings from d-c are 25 amperes 0-24 volts, 3 amperes 25-125 volts, 1 ampere 125-230 volts and contact ratings for operation on a-c 60 cycle circuits are 25 amperes 0-250 volts, 15 amperes 251-440 volts. Relays are available with back connected terminals and numerous types of enclosures. Ward Leonard Electric Co., Mt. Vernon, N. Y.



WARD LEONARD RELAYS

MITCHELL brings you

Rad-i-Air

the first complete line of GERMICIDAL EQUIPMENT

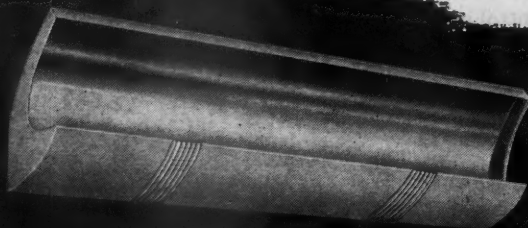
*...protects humans
and animals against
airborne infections
...protects products
against contamination
and spoilage*

Wherever people live, work or congregate indoors . . . wherever animals are housed . . . wherever foods, beverages or medicines are processed, packaged, bottled or sold—there is vital need for the protective benefits of RAD-I-AIR Ultra-violet Germicidal Units! By shortwave irradiation of *maximum intensity* of the germicidal lamp, they kill deadly airborne bacteria, guard against spread of infectious diseases, suppress product contamination . . . with greatest effectiveness, economy and safety.

RAD-I-AIR units are advanced in design . . . sound in conception . . . scientifically perfected. They have already been tested and *proved* under severe operating conditions in homes, offices, stores, hospitals, factories, dairies, on farms, and elsewhere.

Now . . . after years of pioneering development . . . RAD-I-AIR unlocks the door to a huge, untapped market that offers you unlimited sales volume and substantial profits. For, never until now, has a *complete* line of correct, moderately priced, easily installed Germicidal equipment been available. Take the lead in your market—be first with RAD-I-AIR—and cash in on this golden opportunity!

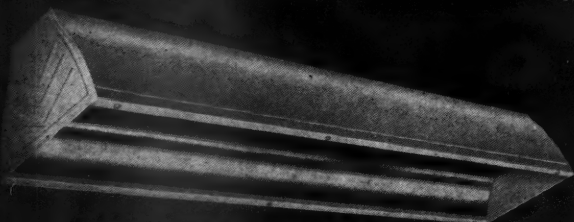
You Get Complete, Abundant Sales Aids . . . Catalogs, Sales Manuals, Folders, Stuffers, Newspaper Mats . . . Everything to help you sell. Write for them now!



RAD-I-AIR U.R.C.
Models No. 921-15 and 921-30
For Personal Protection



RAD-I-AIR ALL-PURPOSE
Models No. 981-15 and 981-30
For Animal and Product Protection



RAD-I-AIR CONVEYOR LINE
Models No. 961-15 and 961-30
*For Direct and Indirect
Product Protection*

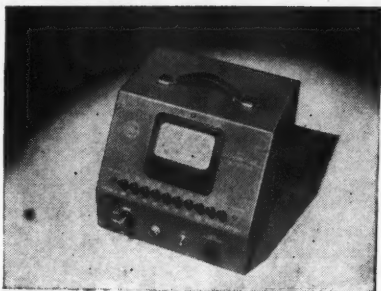


RAD-I-AIR BARE LAMP
Model No. 931-15
*For Protection of Meat
and Meat Products*

TRU-AIR ULTRAVIOLET PRODUCTS COMPANY, 1019 N. Madison Ave., Los Angeles 27, Calif.
Division of MITCHELL MANUFACTURING COMPANY, Chicago

Vacuum Tube Voltmeter

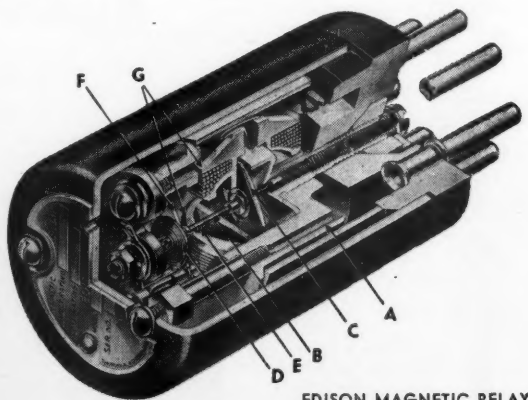
A new high-sensitivity vacuum tube voltmeter designed especially for laboratory and industrial electronic testing is available. Identified as Type AA-1, it has ten calibrated voltage ranges, the lowest being 10 millivolts and the highest 300 volts. The instrument can be used between 10 to 15 cycles, and 1 to 1.5 megacycles. A ten-position pushbutton switch allows any working range to be selected. General Electric Company, Schenectady 5, N. Y.



G-E VOLTMETER

Magnetic Relay

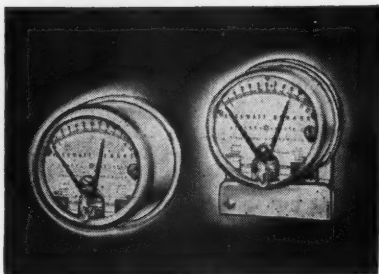
This sensitive magnetic relay Model 103, designed and built to meet the requirements of the aircraft industry, is now available for use in the electronic and industrial fields where relays are required for operation on currents of thermocouple and photocell magnitudes. It is useful as a polarized relay in vacuum tube circuits, in balanced circuits, and in applications requiring pull in and drop out at essentially the same current or voltage. Mechanism is protected against weather and dust by a gasketed metal cover. The essential design is an inversion of the d'Arsonval galvanometer type movement in that the permanent magnet swings and the coils are stationary. The contacts will handle one third ampere in a non-inductive load circuit; and provide either SPST or SPDT switching. Instrument Division, Thomas A. Edison, Inc., West Orange, N. J.



EDISON MAGNETIC RELAY

Instrument

A new thermal watt-demand meter, operating on the "direct-heat" principle and known as Type HI-1, has been announced. This principle is based on the use of temperature-sensitive, bi-metallic spirals that act as their own heaters. The temperature-sensitive elements are attached directly to a shaft and gear. As the electric energy



G-E INSTRUMENT

flows through the thermal element, the heat produced causes the spiral to deflect, thus rotating the shaft and gear, which drives a red pusher pointer. Maximum demand is indicated by a black pointer, which is pushed up-scale by the red pointer. The "direct-heat" principle has also been applied to a single-phase, kva. demand meter. The meter is housed in a glass case, coated on the inside except for the circular front opening. General Electric Company, Schenectady 5, N. Y.

Wall Heater

A new electric fan type wall heater has been announced. Each heater contains a turbine type 16 blade fan built in behind the electric heating element and driven by a special 4 pole induction motor that forces the warm air out over a wide area. The horizontal grille work is so designed as to control the passage of warm air down toward the floor. The fan may be used in summer independently of the heating element to circulate cooling air throughout the home, office or factory. Heaters are available with either manual or thermostatic control in 2, 3 or 4 kw. models. Thermador Electrical Manufacturing Company, 5119 District Blvd., Los Angeles 22, Calif.



THERMADOR WALL HEATER

Energy Storage Capacitors

This line of capacitors for energy storage applications is designed for the fields of flash photography, discharge welding and impulse generation. Each unit is provided with an extra large number of internal connections in order to minimize inductance. Also, to handle the high currents involved, units are divided into many sections to reduce the currents in individual connections. This line covers watt-second ratings from 50 to 540, in voltages from 2000 to 4000 inclusive. Aerovox Corporation, Power Division, New Bedford, Mass.



AEROVOX CAPACITORS

Vaportight CONDULETS

for electrical installations that are exposed to weather, moisture, steam or non-combustible dust

The illustrations show a representative selection from the hundreds of different Vaportight Condulets that are listed in Crouse-Hinds Condulet Catalog 2500. Many other Condulets can be furnished with gaskets that make them Vaportight and Weatherproof.

CONDULETS are made only by CROUSE-HINDS

No. 10

of a series of advertisements which demonstrate that CROUSE-HINDS "complete line" means much more than just a range of sizes — there is a wide variety of highly specialized types in each classification.



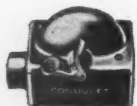
Type X Obround Condulet with Vaportight Gasket



Type AHG Vaportight Flexible Fixture Hanger



Type FSC Condulet with Vaportight Gasket



Type FS Vaportight Switch Condulet



Type GSC Condulet with Vaportight Gasket



Type FD Vaportight Switch Condulet



Type GRT Condulet with Vaportight Gasket



Type FD Vaportight Switch Condulet



Type C Obround Condulet with Vaportight Switch



Type FS Vaportight Triple Switch Condulet



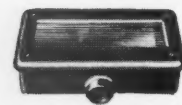
Type FSC Vaportight Push Button Station Condulet



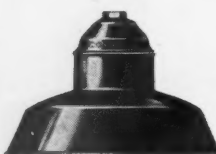
Type FSC Vaportight Plug Receptacle Condulet



Type VPH Vaportight Indirect Lighting Condulet



Type FS Vaportight Lighting Fixture



Type VDB Vaportight Lighting Condulet 500-Watt



Type VG Vaportight Lighting Condulet



Type GS Vaportight Lighting Fixture for GS Series Condulets



Type VDA Vaportight Lighting Condulet with Dome Reflector



Type V Vaportight Lighting Condulet for mounting on machines



Type V Vaportight Heavy Duty Lighting Condulet with Shatterproof glass for use in the food industry



Type VDA Vaportight Tank or Vat Light



Type VXJ Vaportight Lighting Condulet for making extensions from concealed conduit wiring



Type ARC Vaportight Lighting Fixture for Obround Condulets



Type VC Vaportight Lighting Condulet



Type VS Vaportight Hand Lamp with Rubber Handle

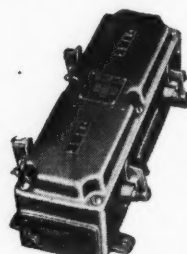
Type V Vaportight Lighting Condulet with Dome Reflector



Type VDA Vaportight Lighting Condulet with Angle Reflector



Type RCD-8 Vaportight Lighting Fixture for wall mounting

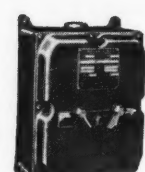


Type YSW Vaportight Circuit Breaker Condulet

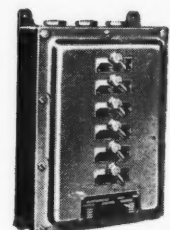
Type VFC Vaportight Gauge Lighting Condulet



Type WV Vaportight Lighting Condulet with Fresnel Lens



Type DVS Dust-Tight and Vaportight Circuit Breaker Condulet

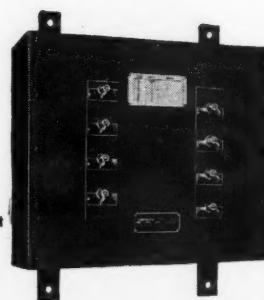


Type DVS Dust-Tight and Vaportight Circuit Breaker Condulet

Type VJ Vaportight Lighting Condulet



Type VLG Vaportight Gauge Lighting Condulet Fluorescent



Type DVP Dust-Tight and Vaportight Panelboard

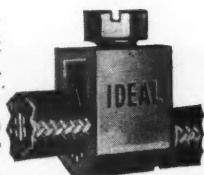
CROUSE-HINDS COMPANY
Syracuse 1, N. Y., U.S.A.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — San Francisco — Seattle — St. Louis — Washington. Resident Sales Engineers: Albany — Atlanta — Charlotte — Indianapolis — New Orleans
CROUSE-HINDS COMPANY OF CANADA, LTD., Main Office and Plant: TORONTO, ONT.

CONDULETS • TRAFFIC SIGNALS • AIRPORT LIGHTING • FLOODLIGHTS

Split Bolt and Service Entrance Connectors

To supplement this line of wire connectors and lugs, a new line of split bolt connectors and service entrance connectors has been developed. The split bolt connectors are available in two types, "One Piece" and "Two Piece" with small and large heads. They are also available either in bronze, brass, or aluminum. There are no burrs, ends, or sharp edges to catch in the lineman's gloves, it is claimed. A wide range of sizes accommodate all solid and stranded wire from No. 6 to 1,000,000 CM. The service entrance connectors are made from cold drawn copper with the screws made from Everdur. There are five sizes from No. 12 solid or No. 10 stranded to No. 2 stranded. Ideal Industries, Inc., Sycamore, Ill.



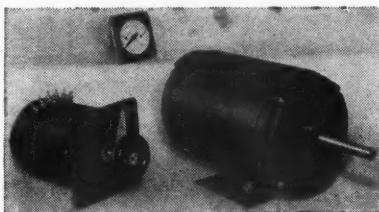
SERVICE ENTRANCE



IDEAL SPLIT BOLT

Positioning and Indicating Equipment

Accurate d-c positioning and indicating equipment which can be operated from any a-c or d-c line is announced for general industrial use wherever remote indication and control systems are employed. This equipment, consisting of receivers and transmitters, is for applications in oil fields, steel mills, steam or hydro-electric plants, and on shipboard, according to the manufacturer. Specific uses include governor and generator field control systems for multiple synchronized diesel-electric drives, master remote control for revising mill motors, remote Ward-Leonard control systems for multiple diesel-electric power plant mobile units, and remote indication or control over mechanical, electrical or hydraulic devices such as level, pressure and flow indicators. The transmitter, which is essentially a variable resistance bridge, operates manually or automatically, controlling the relative strength of the receiver magnetic fields. Allis-Chalmers Mfg. Co., Milwaukee, Wis.



ALLIS-CHALMERS UNIT

Spot Welder

Added to the Universal line of 1 kva. and 3 kva. air operated midjet bench type spot welders is the Universal USP-7½. It is a plug-in type and includes solenoid valve control of air cylinder, pressure switch and can be furnished with built-in NEMA 1-A electronic timer. It is also available with NEMA 3 B or 5 B in separate timer panel. The solenoid valve control of air cylinder by adjustable pressure switch provides a wide range of uses for

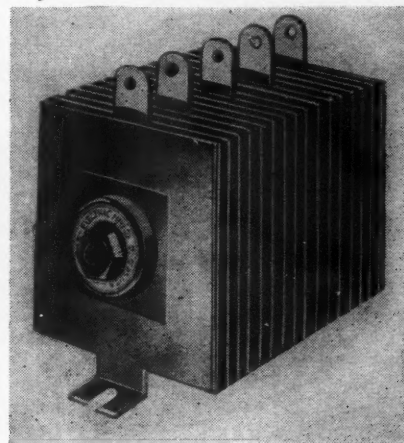


SPOT WELDER

welding non-ferrous metals and wire. Unit is equipped with air filter, pressure gauge and automatic lubricator. Starting of welding cycle is by electric foot switch and it is equipped with water cooled transformer and electrodes. Davis & Murphy, Davis Building, 5252 Broadway, Chicago 40, Ill.

Copper Sulphide Rectifier

A dry disc metallic rectifier which does not require forced cooling has been announced. This rectifier is rated 50 amperes for 6 volt automotive battery taper charging. Two rectifiers may be operated in parallel from separate transformer secondaries to provide 100 amperes maximum charging rate without a fan.

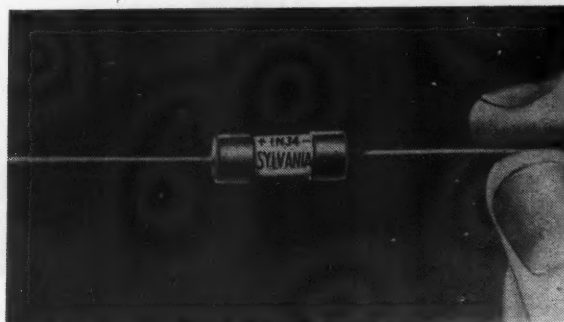


BENWOOD-LINZE RECTIFIER

Battery chargers of this type, designed to charge 6 volt batteries, operate from the usual 110 volt a-c power supply, to deliver the required rating of d-c to the battery. The Benwood-Linze Company, 807 Locust Street, St. Louis 3, Mo.

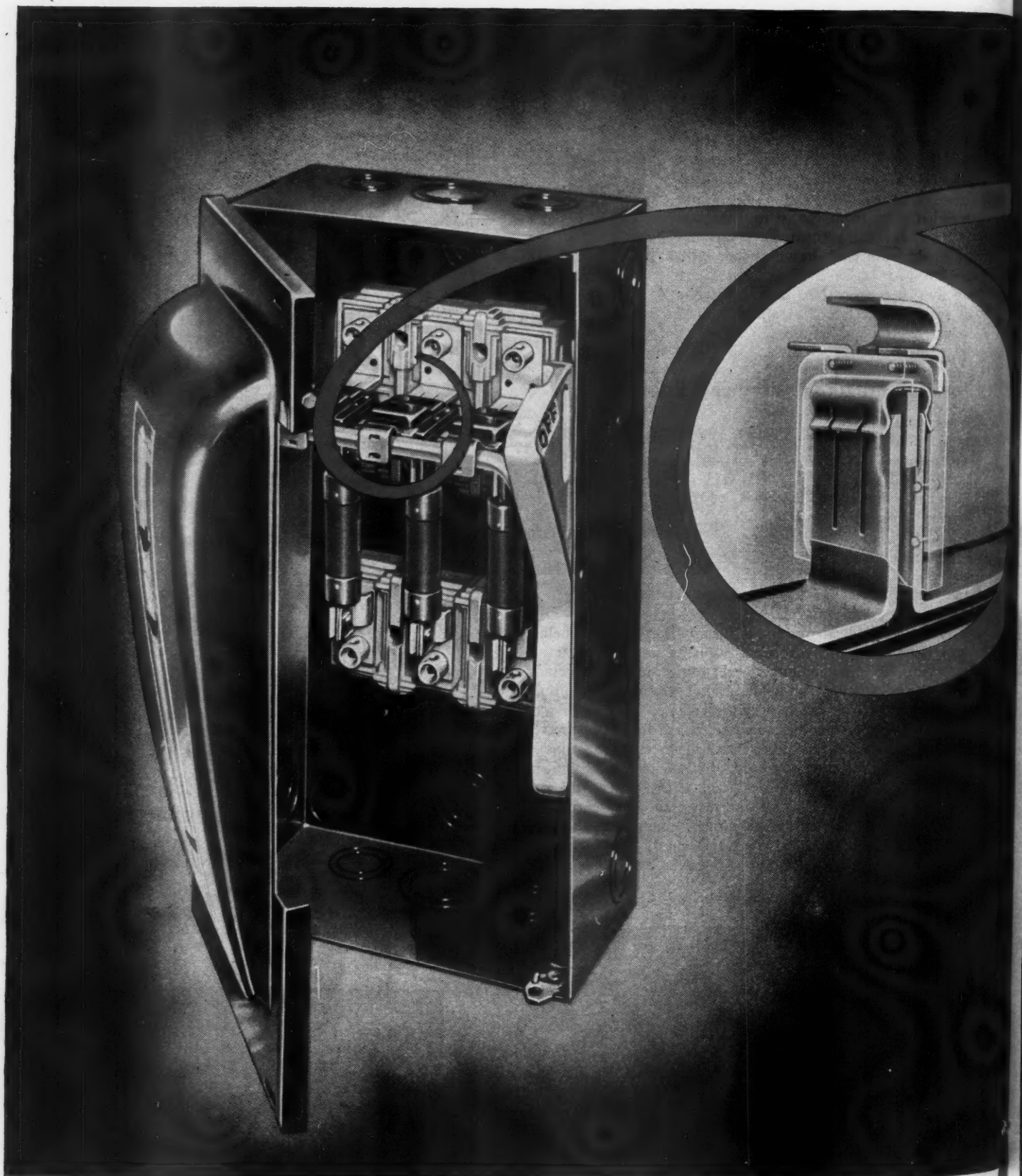
Crystal Diodes

Germanium crystal diodes are suitable for use as second detectors and d-c restorers in television receivers; frequency discriminators in FM circuits; first detectors; modulators and demodulators; low frequency oscillators; voltage regulators; and polarizing devices. Other applications include volume limiters; square wave clippers; varistors; noise silencers; meter rectifiers; volume expanders and volume contactors. Supplied in tiny cartridges measuring .75 inch by .25 inch, they may be wired directly into circuits by means of tinned copper leads. Electrical features include small inter-electrode capacitance; small shunt capacitors; low forward resistance; high back resistance; ability to work into a low resistive load; elimination of heater supply, noise and a-c hum. Sylvania Electric Products, Inc., Boston Mass.



SYLVANIA CRYSTAL DIODES

Less arcing...longer

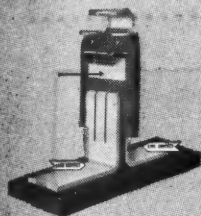


Streamlined for attractive appearance and closer banking of switches, the famous Bull Dog Vacu-Break Safety Switches are available in a wide variety of sizes and types for every industrial requirement. Capacities range from 30 to 1200 amps.; 2, 3 and 4 poles.

life...with Bulldog Vacu-Break

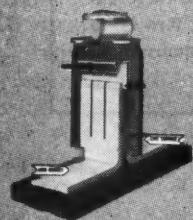
Safety Switches

EXCLUSIVE *Vacu-Break* AND CLAMPATIC CONTACT FEATURES



"CLAMPATIC" SWITCH
CONTACTS

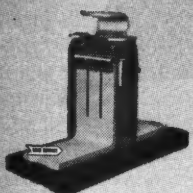
With formed Bakelite cover removed, illustration shows moving contact confined within the slotted section of the arcing chamber, free to engage stationary contacts when switch is operated from "OFF" to "ON" position.



EASY MAKE AND BREAK

(Left) When operated to OFF position, clamping spring first releases its pressure to remove disconnecting resistance.

(Right) When operated to ON position, contact (slug) first engages stationary line and load contacts before clamping spring makes full pressure contact.



BOLT TIGHT CONNECTIONS

Moving contact (slug) is held tightly between line and load contacts by clamping pressure spring in full ON position.

SAFETY SWITCHES are the guardians of electric circuits. They keep power on the job. That's why you'll want to weigh the advantages of Bulldog Vacu-Break Safety Switches—for today and for the years to come.

There are six plus values in Vacu-Break Safety Switches—six exclusive design features to make them ideal protective devices for trouble-free operation under heavy production schedules.

1. Less arcing and resultant longer life, because Bulldog's formed "Bakelite Arcing Chambers" confine and suffocate arcs to prevent burning and pitting of contacts.
2. "Clampmatic" switch contacts, providing "clamp type pressure" when contacts are

closed—quicker, easier release when the handle is thrown to the OFF position.

3. Quick action mechanism assures positive "ON and OFF" operation with a minimum number of wearing parts.
4. Ample wiring room is provided without sacrificing compactness.
5. Solderless wire grips.
6. Streamlined handle placed within the cabinet lines to allow front operation and closer banking of switches.

Bulldog Vacu-Break Switches—first in quality and first in safety—keep power on the job to help you speed production and reduce maintenance costs. Get full information now—either by consulting a Bulldog field engineer or by writing us for descriptive folders.

Manufacturers of SafToFuse Panelboards—Switchboards—Circuit Master Breakers—BUStribution DUCT for "plug-in" power—Universal Trol-E-Duct for flexible lighting—Industrial Trol-E-Duct for Portable Tools, Cranes and Hoists.

BULLDOG

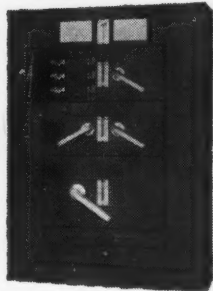
ELECTRIC PRODUCTS COMPANY



Detroit 32, Michigan. In Canada: Bulldog Electric Products of Canada, Ltd., Toronto. Field Offices in All Principal Cities.

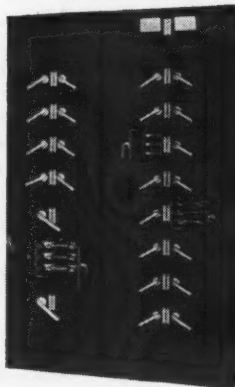
Vacu-Break COMPACT TYPE SWITCH BOARDS

Featuring Quick Make
and Quick Break
Switching with Posi-
tive Arc Control



FINER SWITCH UNITS

Incorporating the exclusive Bulldog Vacu-Break principle, the switch units provide maximum circuit rupturing capacity. They are interlocked with fuses for safety, and are equipped with quick make and break operating mechanism.



NEATER, MORE COMPACT

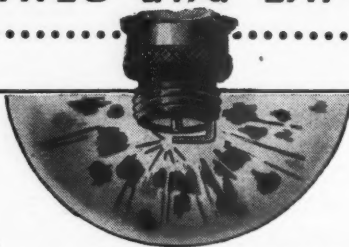
The compact type Vacu-Break Switchboard is made up of standardized units with front operated handles—compact for wall mounting—completely flexible, interchangeable and convertible.

Severest Tests Show How Benjamin *Explosion-Proof* Fixtures *Insure against FIRES and EXPLOSIONS*

Shown here are some of the exacting laboratory tests which Benjamin Explosion-Proof Lighting Equipment must pass... and do pass with flying colors!

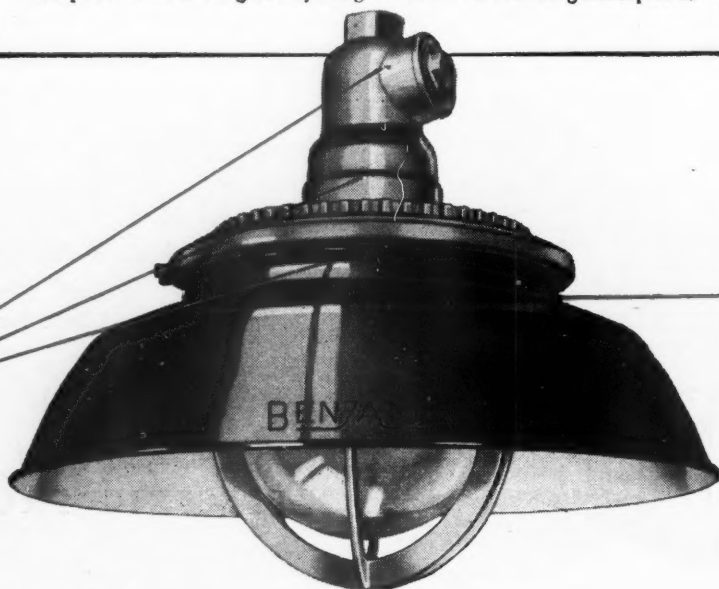
The dependability and safety of Benjamin Explosion-Proof equipment is to be found not only in the passing of these stringent laboratory tests but in the years of safe service it has rendered in thousands of installations throughout Industry.

In the solution of special lighting problems involving the use of this equipment, Benjamin's experience and engineering recommendations are available to you without cost or obligation. Write for Free Data Bulletins containing detailed information concerning all of Benjamin's hazardous location lighting units, all of which bear the label of the Underwriters' Laboratories and conform with all requirements of the National Electrical Code. Address Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Illinois.



Thirty Severe Spark Plug Tests Demonstrate How Benjamin Explosion-Proof Fixtures Confine Explosions to Interior of Fixtures!

In this test, a spark plug is used to create ignition of explosive mixtures within the fixture. THIRTY EXPLOSIONS are thus created at 380 lbs. per sq. in. pressure! Benjamin units withstand these explosions. The fixture is neither destroyed nor damaged! There is no escape of flames or dangerously hot gases to the surrounding atmosphere.



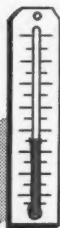
Flame Proof Joints

All threaded and flanged joints in the fixture are made to a specified depth that positively insures against passage of flame.

Approved by Underwriters' Laboratories for use in Class I, Group D hazardous locations. Under labeled re-examination service units are taken from the production line and periodically checked by the Underwriters' Laboratories to insure conformance to their rigid standards.

FOR LIGHTING SUCH LOCATIONS AS...

Oil Refineries, Lacquer Spray Painting, Natural Gas Plants, Dry Cleaning Plants, Artificial Leather Manufacturing, Paint and Varnish Works, Oil and Gas Wells, Pyroxylin Plastics, Moulding, Distilleries, Chemical Plants, Lino-leum and Oilcloth Manufacturing. Pipe Line Pumping Stations, and other locations where highly flammable gases, mixtures or other highly flammable substances are used, handled, or stored in other than their original containers.



Temperature Controlled

Every Benjamin Explosion-Proof fixture operates at a carefully controlled temperature that precludes any possibility of the fixture heat causing an explosion in the explosive atmosphere in which it is installed.

BENJAMIN

TRADE MARK



Lighting Equipment

Distributed Exclusively through Electrical Wholesalers

INDUSTRIAL ELECTRIFICATION

ENGINEERING • INSTALLATION • MAINTENANCE

Selecting Industrial Control—Part III

Third of a series discussing group fusing, reduced voltage starters, reversing starters and multi-speed motors and their controls.

QUITE a bit is heard now about group operation of small motors, popularly referred to as "group fusing". It originated with manual starters in the textile industry and is now recognized in a somewhat different form by the machine tool manufacturers.

It can best be discussed by starting with a standard motor circuit as shown by the single line diagram. Here the motor is operated on its individual branch circuit. This branch circuit leaves the feeder through a fused disconnect switch or a circuit breaker (sometimes through fuses only, the disconnect switch being located closer to the motor). The disconnect switch serves to isolate the line whenever inspection or repairs may be necessary on the motor, its starter or control circuit. The fuses protect the line and starter in case of a short circuit*, and are rated in accordance with the National Electrical Code at about three times full load motor current, never over four times. Overload protection for the motor is provided as a part of the starter in most cases. Thermal relays will handle the stalled rotor motor current, but in the event of a short circuit the relay is much too slow in operation and the rupturing capacity of the contactor likewise too low to handle the high current. The starter and relay are protected (as defined in the footnote) by the fuses or circuit breaker, and this protection is not assured if the fuse size exceeds four times the full load motor current.

*Strictly speaking this is incorrect. Regular fusing protects the line and it protects the heaters against burnout. It does not really protect the starter; the contacts may weld and the starter be practically worthless in extreme cases. The damage to the starter (if any) will depend on the factors enumerated in the text; it is considered "protected" when the damage is so restricted that no explosion or fire hazard results when the starter is tested in a standard enclosure.

By **Richard Pitt Ballou**
Chief Engineer
Federal Electric Products Co.

In contrast to the circuit just described several motors, each with its individual starter and overload protective device, may be operated from the same branch circuit. The size of the conductors, as well as fuses or circuit breaker, must be adequate for the load. Obviously if there are more than two such starters it will be necessary to have the fuse size greater than four times the

full load current of at least one of the motors*. With this increased fuse size the motor starter is not protected from a short circuit and in case of a short the relay heaters may burn out and the starter be otherwise damaged. The extent of the damage, if any, will depend on the magnitude and duration of the short circuit current. These values will depend on the voltage, capacity of the transformer, length and size of conductors, number and size of fuses, switches, etc. in the line, the means by which the short is produced and the phase angle of the circuit at the instant of short circuit (transient effect). Where the likelihood of a damaging short is small and the number of starters involved is large, the user may feel justified in assuming the responsibility for damage to a starter in order to reduce the number of fuses and disconnects necessary.

However, he should remember that if any trouble is encountered with any motor or starter (it doesn't have to be a short) it is necessary to disconnect the entire circuit while repairs or alterations are made. This shut-down of a number of motors may be costly, especially where production schedules must be maintained, so in practice it is frequently desirable to limit group fusing to motors driving different parts of the same machine, or to motors driving several machines in a single process or chain of operations.

Group fusing is recognized by the National Electrical Code for starters which have been approved for this application. In testing a starter for group fusing, the Underwriters' Laboratories

*This is for normal acceleration. Occasionally three small motors can be used if they start independently and have low starting currents or rapid acceleration.

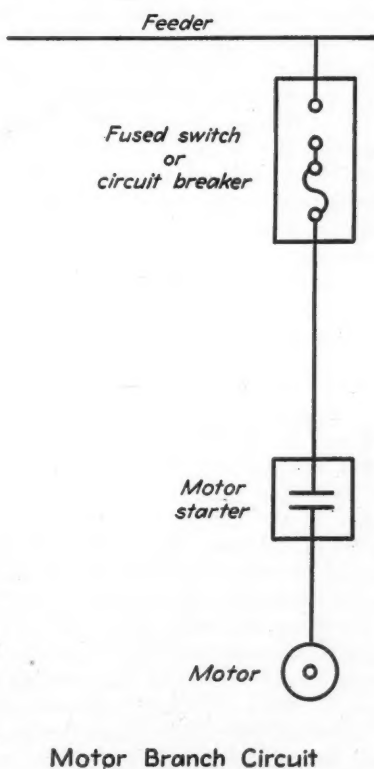


Fig. 1—Common type of motor branch circuit with individual protection.

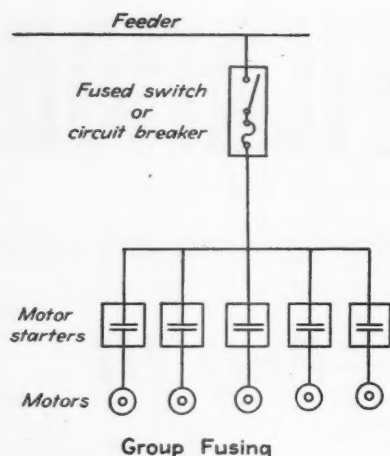


FIG. 2—Typical circuit for fusing groups of small motors.

first test it in the usual manner for use with fuses of normal rating; it is then tested for use with fuses not larger than those specified by the manufacturer and printed on the device. In practice, these fuse sizes vary with the heater sizes. On this test the heaters are permitted to burn out and the starter may be damaged to any extent that does not create a fire hazard or other danger outside the enclosure.

In 1942 the National Machine Tool Builders' Association, through the American War Standard of the American Standards Association (A.S.A. C-74-1942) recognized a somewhat different version of group fusing. It accepted heaters of any rating, on starters of any size, without special approval tests, when the starters were mounted within the frame of the machine (under conditions further specified in the Standard) and protected by fuses not exceeding 200 amperes on 220 volt lines or 100 amperes on 440 or 550 volt lines.

But for many years control manufacturers have been making special control panels for several motors on one machine, and mounting the component starters in a single sheet steel enclosure. These had no official recognition, but were generally accepted by local inspectors for two very excellent reasons:

(1) The hazard is recognized as very slight. Load wiring is generally done by a machine tool manufacturer; in any event it is so short and well protected that the likelihood of a short circuit is very remote. If a short circuit should occur the volume of the enclosure surrounding several starters is so large that the flash is effectively constrained to the interior and even a phase-to-phase short circuit within the enclosure will seldom generate a dangerous pressure.

(2) In normal operation there are many advantages in having a common line circuit. One is that when there is occasion to inspect or adjust the control panel it is only necessary to pull one

disconnect switch to kill all circuits. Another is that it makes convenient the electrical interlocking of certain machine functions in the further interests of machine and personnel safety.

It is unlikely that there will be any immediate change in the policy of supplying this type of control panel. The tendency is more toward giving some form of official recognition to it.

It has been mentioned that most manual starters may be operated on a properly fused line without other disconnecting means. This cannot logically be extended to cover group operation since with the larger fuses the damage possible to the starter is such as may completely invalidate it for any disconnecting use. However, a main disconnecting switch for the group is generally required anyway as a matter of convenience and is usually incorporated with the fuses.

Multi-Speed Motors and Their Controls

To discuss this subject we shall depart somewhat from our regular procedure, and instead of discussing the controller, we shall consider at some length the motor itself. This is because the controller is required to follow the pattern set by the motor so that a thorough understanding of the requirements of the motor is necessary for an intelligent selection of a controller for it.

The motor starter starts and stops the motor, and normally affords overload protection. To cause the motor to run at a particular speed, the motor must be connected to the line in the exact manner intended by the motor manufacturer. There are a great many ways of connecting up motors, and while all of the common ones at least are well known to the control manufacturer, he must know which of the many connections is used in the motor for which his control is intended in order to supply the proper control.

To avoid confusion, it is customary for the control manufacturer to ask for an adequate description of the motor rather than to attempt to list an almost incomprehensible variety of starters in his catalog.

There are a few features of control which are optional, and depend either on the whim of the customer or the nature of the driven load, rather than on the motor itself. One of these is the type of enclosure. Another is the addition of a relay to require that the motor be started at its lowest speed. A third is a relay that automatically accelerates, or decelerates the speed by the pressing of a single button. A fourth is the omission of overload protection from the speed used for plugging. Such features are usually shown in the control manufacturer's catalog.

Induction Motor Speeds

The synchronous speed of an induction motor depends on the frequency and the number of poles, and the actual speed will be slightly less than the synchronous speed due to slip. Thus a 4-pole, 60-cycle motor has a synchronous speed of 1800 rpm. and may have an actual full load speed of 1725 or 1750 rpm.

For 60 cycles the speed is 3600 divided by the number of pairs of poles: thus a 2-pole motor has a speed of 3600 rpm. and an 8-pole motor has a speed of 900 rpm.

Multi-speed motors have two or more definite speeds as in the illustrations above. They are different from variable speed motors, which are generally adjustable to an infinite number of speeds within a narrow range. The method of speed control on a variable speed motor depends on the type of motor, and the three most common and well-known methods are by a variable resistance in the rotor circuit of a slip ring induction motor, a rheostat or variable resistance in the line of a series motor, and a field rheostat with a universal or a d-c motor.

But the multi-speed induction motor has a very limited number of definite speeds which are determined by changing the number of poles. The motors are designed and built for the specific speeds required, and the control is thereby prescribed in that it must accommodate the number and types of windings on the motor, connecting and reconnecting them in accordance with the motor manufacturer's preconceived plan.

Motor Classifications

Multi-speed motors can be classified according to their operating characteristics, or constructional features.

According to operating characteristics, they are classified as "constant horsepower", "constant torque" or "variable torque". (Other classifications as with respect to normal or low starting current, normal or high starting torque, etc., are characteristics to be considered in selecting the motor, but generally have no bearing on the type of multi-speed control.)

According to construction, they are classified as "reconnectable" or "separate winding" motors. The reference is solely with respect to the windings, other points of design or construction having no bearing on the control other than, in some cases, the selection of heaters for the overload relays.

Motors Classified by Characteristics

A fundamental equation to consider is this:

$$\text{Horsepower} = \text{Torque} \times \text{Speed}$$

In practice, torque and speed are conveniently expressed in units which re-

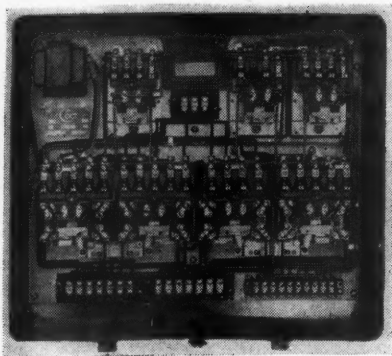


FIG. 3—Starter with control circuit transformer for 4-speed, constant, torque, overlapping speed, consequent pole motor.

quire multiplication by a constant to give horsepower, but we are not considering actual numerical values, so will omit the constant. (If torque is in pound-feet and speed in rpm. the constant is 0.000194.)

Now we are talking about multi-speed motors. It is obvious from the above equation that as the speed changes either the horsepower, or the torque (or both) must change, and the motors are classified according to what changes (or does not change), as follows:

(1) **Constant Horsepower Motors.** Motors which deliver the same horsepower at all speeds. The torque is inversely proportional to the speed. Such motors are used on a number of machine tools, lathes, etc.

(2) **Constant Torque Motors.** Motors which deliver the same torque at all speeds. The horsepower is proportional to the speed, and the motor is rated according to the horsepower at the maximum speed. These motors are used on conveyors, stokers, etc., and on some machine tools.

(3) **Variable Torque Motors.** Motors wherein the torque varies directly with the speed, and the horsepower, consequently, as the square of the speed. The motor is rated according to the horsepower at the maximum speed. Such a motor rated at 3 hp. at 1800 rpm. would only deliver $\frac{3}{4}$ hp. at 900 rpm. The application is on fans, pumps, etc., where the load increases with the speed.

Motors Classified by Construction

The number of poles on a motor is determined by the way the stator is wound. A single winding may be used, connected one way to produce a given number of poles, and another way to produce just half (or twice) that number of poles. Since the winding is reconnectable, the motor is frequently called a reconnectable winding motor. It is also called a Consequent Pole Motor. Both of these terms are heard and used interchangeably.

Instead of using one winding and re-connecting it for the two speeds, the stator may have two separate windings on it, one giving a certain number of poles, and the other giving any other desired number of poles. Such a motor is called a separate winding motor.

The Consequent Pole Motor has some advantages in size and cost, but to keep the number of leads to a practical limit the two speeds must always be in the ratio of 2:1, while the separate winding motor can have any two speeds that are desired, subject only to the general restrictions on speeds of induction motors as discussed earlier.

What has been said applies in theory to both two-phase and three-phase motors, but in practice two-phase motors are constructed with separate windings. A consequent pole motor is, therefore, a three-phase motor. There are a few single phase capacitor type multi-speed motors, but they are so special that they are not discussed herein.

Windings for Multiple Speeds

The principle of the consequent pole motor is, briefly, that six leads are brought out. For one speed three of

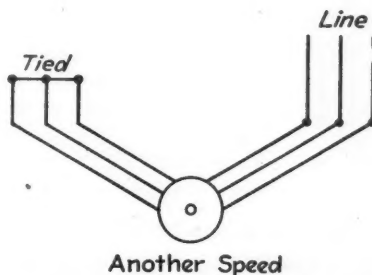
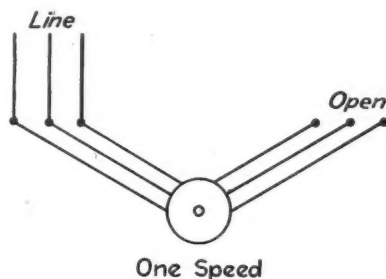


FIG. 4—Typical multiple speed motor connection.

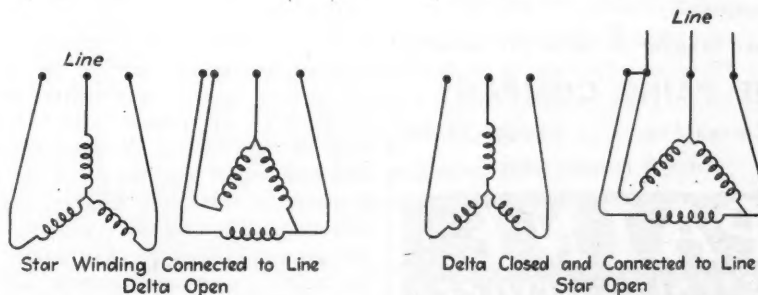


FIG. 5—Separate winding motor connections for multiple speed operation.

these are connected to the line and the other three are open; while for the other speed the line is connected to the second three and the first three are tied together or "shorted" as shown in Fig. 4.

There is no essential difference between the starters for consequent pole motors, except the way the terminals are marked. However, all starters for constant horsepower motors, whether consequent pole or separate windings, are de-rated. Starters for constant torque or variable torque motors are rated the same as the corresponding size contactor or starter, but the ratings are only about two-thirds as great for constant horsepower motors. This is because of the heavier current required to produce the higher torque at the slow speed.

The separate winding motor is easy to understand—the starter connects to the line the winding corresponding to the speed desired, and other winding or windings being open.

In the case of the 2-phase motor the above simple statement is complete, since there is only one type of winding, whether it be for 2-phase 3-wire or 2-phase 4-wire. But 3-phase motors can be wound star (Y) or delta (Δ). The Y winding is the most common, but if any winding is delta, provision must be made for opening one corner of it when not in use, otherwise a circulating current would flow in the delta winding when any other winding became energized. For this purpose the motor manufacturer brings four leads out from the delta winding and an extra set of contacts is required on the motor starter to close the delta, illustrated in Fig 5.

A 2-speed separate winding motor can have either winding Y or delta, so that there are four possible combinations. However, since the combination of both windings in delta is not used in practice, we say that there are three combinations, viz:

- (1) Both windings Y
- (2) Low speed Y and high speed delta
- (3) Low speed delta and high speed Y.

A starter for a 3 phase separate winding motor must provide for the delta winding if there is one; therefore, full information must accompany the order.

PAINE DRILL BITS Dig Into



MASONRY AND CONCRETE

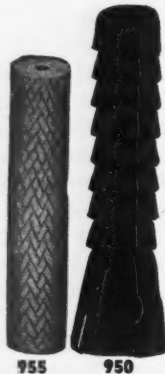
Whether you drill by hand or with a rotary drill, Paine Drill Bits add speed and accuracy to the operation.

365—"Sudden Depth"
Carbide Tipped Drill Bit can be used in any rotary drill (slow speed). Available in sizes 3/16" through 1 1/4" diam. (graduated in 1/16" sizes.)

375—Star Drill Bit—forged from the finest tool steel for long service. Available in 4 point sizes.

PAINE WOODSCREW ANCHORS

LEAD AND FIBER TYPES
Fasten electrical equipment and fixtures to tile, marble, concrete, slate, wood or wood furring with Paine Woodscrew Anchors. They provide firm, dependable anchorage easily and cheaply. They require no setting tool and hole need not be plumb. Available in a wide variety of sizes.



PAINE CONDUIT CLAMP

Hang rigid or thin wall conduit . . . efficiently . . . easily with a Paine Conduit

Clamp. The special offset feature holds the clamp away from the wall—facilitating installation and maintenance. Stove bolt is already inserted in each clamp to speed buying and installing. Guaranteed rustproof.

Ask your Supplier or write for catalog.

THE PAINE COMPANY

2961 Carroll Ave. Chicago 12, Ill.

Offices in Principal Cities

PAINE
FASTENING
and HANGING DEVICES

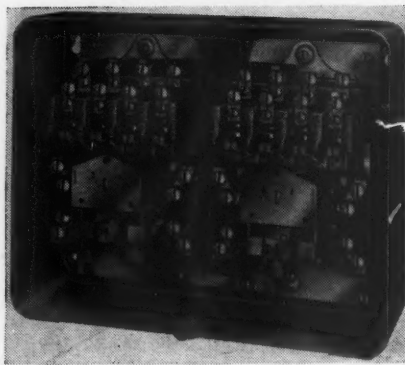


FIG. 6—Magnetic motor control, remote control side by side; 2 speed separate winding.

A 2 phase motor takes the same starter as a 3 phase motor with both windings Y connected. This is also the most common method of motor connections even with three phase.

Three and four-speed starters operate on the same principle as two-speed starter, and the discussions of motors by classification and by characteristics apply to motors of any number of speeds.

Three-phase separate winding motors for three or four speeds make possible quite a number of combinations of windings, but involve nothing new.

A consequent pole motor produces only two speeds from any one winding, so for three or four speeds another winding is required. For three speeds one winding is reconnectable; for four speeds both windings are reconnectable. A three-speed motor will have two speeds in the ratio of 2:1 while the third speed is independent—it may be higher, lower or in between. A four-speed motor will have two speeds in the ratio of 2:1 and another set of speeds in the ratio of 2:1. These may overlap, exemplified by speeds of 1800, 1200, 900, and 600, where the speeds 1800 and 900 are in the ratio 2:1, as are also the speeds 1200 and 600; or they may extend, as 3600, 1800, 900, 450, the speeds found commonly on motor-head wood-working lathes. In order that the starter terminals may be properly marked it is necessary to know the actual speeds.

Overload Protection

Multi-speed motor control generally includes overload protection for each speed. The currents will not be the same at the different speeds. They may vary by 2:1, or even more, depending on the type of motor, the number of speeds, the actual speeds, and other factors. Obviously, we cannot select heaters from average tables. We must know the full load motor current for each speed to properly select the heaters. In case this information is not available when the starter is ordered, the starter may be ordered without heaters and the latter obtained after the motor is delivered or the necessary information

supplied by the motor manufacturer. Heaters should be selected to fulfill their purpose of protecting the motor, and not simply to bridge a circuit.

Drum Controllers

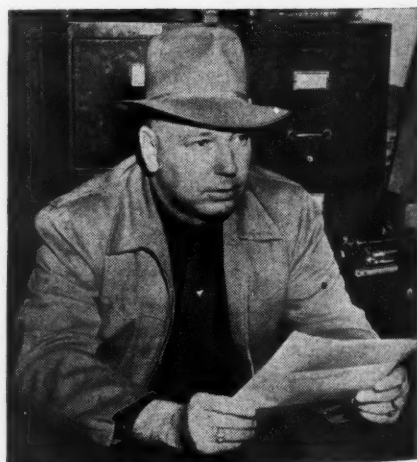
Sometimes drum controllers are used to select the motor speed. This is especially true with more than two speeds, or where reversing is also desired.

These fall into two general classifications—pilot devices, or drum switches, which control magnetic motor starters and are used primarily to give a manual indication of the speed at which the motor is running; and heavier drum controllers, connected in motor circuit.

With a drum controller, overload protection is obtained by a pair of overload relays located in each speed circuit, the control circuit to the magnetic contactor coil passing through the overload relays in series, so the tripping of any relay drops out the magnetic contactor.

Reversing

A Reversing Contactor placed in the line ahead of the multi-speed starter will determine the direction of the motor at the selected speed. In some applications it is only necessary that the motor run in one direction at one speed, and in the other direction at another speed; for example, a milling machine may advance (cut) at low speed, and return at high speed. For this the reversing contactor is not required; instead, when the motor is wired to the multi-speed starter two leads are interchanged on the winding corresponding to the speed at which it is desired to have the motor run in the opposite direction. Any electrician can easily effect this change. However, the reversing contactor is always required when the motor must run in both directions at the same speed.



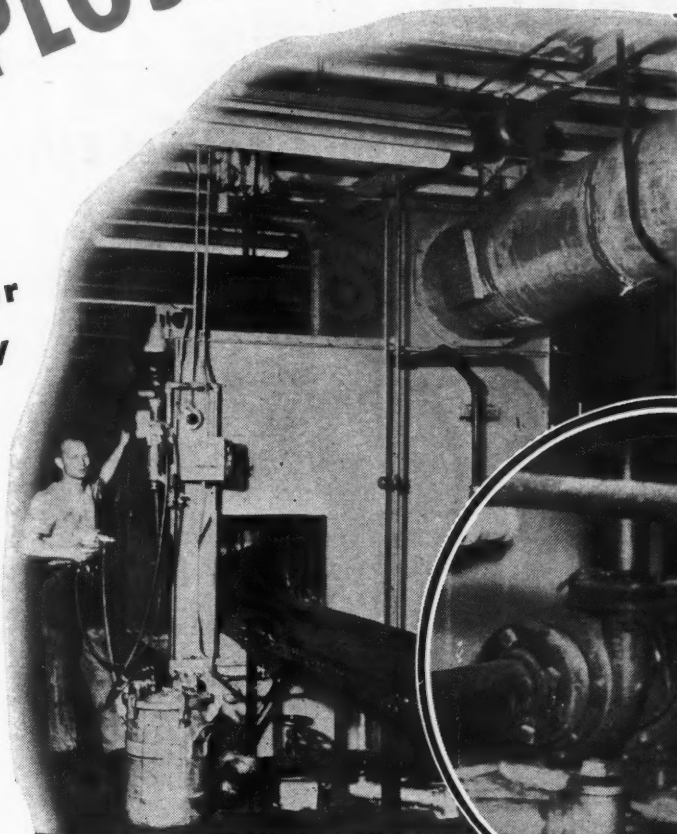
In and out with scarcely a moment of leisure is daily routine for D. L. Zimmerman, owner of the D. L. Zimmerman Electrical Machinery Company, Wichita, Kansas. Specializing in repairs of oil field motors and large transformers, his shop is one of the largest in the state.

Electrical Contracting, June 1946

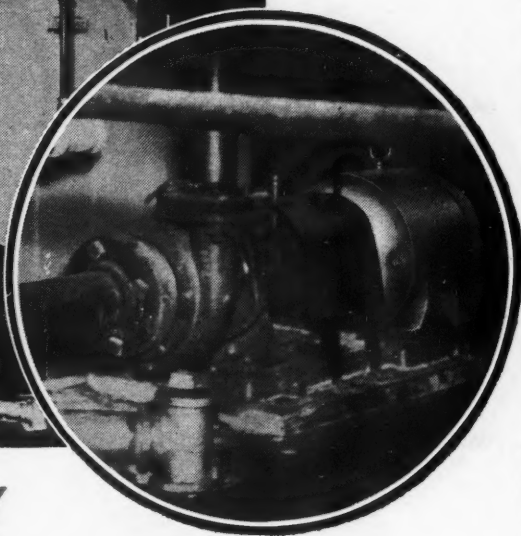
IN EXPLOSIVE ATMOSPHERES—

PROTECT Your
People From Injury

PROTECT
Your Plant From
Costly Shutdowns



Century Explosion Proof motor drives a pump in atmosphere charged with explosive paint thinner vapors.



with **CENTURY** **EXPLOSION PROOF MOTORS**

Where atmospheres are charged with such explosive mixtures as alcohols, acetone, solvent vapors, natural gas, gasoline, naphtha, grain dusts, etc., Century Explosion Proof motors will give you maximum protection against explosions and fire.

Century Explosion Proof motors are built to meet all standard operating characteristics — high torque, low torque, normal torque, multispeed. The inner frame of these motors is enclosed so that mechanical operating parts and electrical connections are completely sealed from the outside atmosphere.

A blast of cooling air is forced by large ventilating fan between the



inner and outer frames. This keeps the operating temperature down and blows dust and dirt out.

Engineered to the functional characteristics of the machines they drive to assure top performance — Century motors are a vital factor in building a better product at a lower cost. Specify Century motors on all your electrically powered equipment. Built in sizes from 1/20 to 600 horsepower.



CENTURY ELECTRIC COMPANY 1806 Pine Street, St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

J-1

Slimline Lamp and Ballast Efficiencies

SLIMLINE EFFICIENCIES

(Based on G. E. Lamps and Ballast Data)

Lamp	Ballast	Power Factor	Number Lamps @	Operating Milliamps	Lamp Watts	Ballast Watts	Total Watts	Lumens	Eff. Lumens Per Watt
42-T-6	59 G-501	Low 45%	1	100	15	11.0	26.0	900	34.60
"	59 G-533	High 95%	1	100	15	10.0	25.0	900	36.00
"	59 G-565	High 95%	2	100	30	11.5	41.5	1800	43.40
"	59 G-505	Low 32%	1	200	25	15.5	40.5	1400	34.55
"	59 G-537	High 95%	1	200	25	17.0	42.0	1400	33.35
"	59 G-569	High 95%	2	200	50	18.0	68.0	2800	41.15
64-T-6	59 G-509	Low 45%	1	100	23	12.5	35.5	1400	39.50
"	59 G-533	High 95%	1	100	23	17.0	40.0	1400	35.00
"	59 G-573	High 95%	2	100	46	15.0	61.0	2800	45.90
"	59 G-513	Low 40%	1	200	38	22.0	60.0	2150	35.80
"	59 G-537	High 95%	1	200	38	17.0	55.0	2150	39.10
"	59 G-577	High 95%	2	200	76	24.0	100.0	4300	43.00
72-T-8	59 G-509	Low 45%	1	100	22	12.5	34.5	1400	40.60
"	59 G-533	High 95%	1	100	22	10.0	32.0	1400	43.70
"	59 G-573	High 95%	2	100	44	15.0	59.0	2800	47.40
"	59 G-513	Low 45%	1	200	38	22.0	60.0	2350	39.15
"	59 G-537	High 95%	1	200	38	17.0	55.0	2350	42.70
"	59 G-577	High 95%	2	200	76	24.0	100.0	4700	47.00
96-T-8	59 G-557	High 95%	1	100	30	11.5	41.5	1950	47.00
"	59 G-589	High 95%	2	100	60	16.0	76.0	3900	51.40
"	59 G-561	High 95%	1	200	52	19.5	71.5	3300	46.15
"	59 G-593	High 95%	2	200	104	28.0	132.0	6600	50.00
(Other Fluorescent Lamps for Comparison)									
96 Cold Cath. "Colovolt"		High 99%	2	120	84	25.0	109.0	4400	40.30
48 Hot Cath. 58 G-983		High 95%	2	145	80	15.5	95.5	4200	44.00
48 Inst. Start 59 G-373		High 95%	2	145	80	28.0	108.0	4200	39.00

OPERATING CHARACTERISTICS OF LIGHT SOURCES

Fluorescent Lamps

Description		*On Single Lamp Ballast			*Tulamp Ballasts			Brightnesses	Glass Area	
Color	Diam.	Lamp Watts	Total Watts	Lumens	*L. P. W.	Total Watts	*L. P. W.	Foot Lam-berts	Cen-dles Per Sq. Inch	Sq. In.
Day	T-8	15	19.5	495	25.4	19.5	25.4	1750	3.87	56.5
"	T-12	20	24.5	760	31.0	24.5	31.0	1230	2.72	113.9
"	T-8	30	40.0	1230	30.7	37.25	33.0	2125	4.70	113.9
"	T-12	40	53.0	1800	34.0	48.75	36.9	1480	3.27	227.0
White	T-8	15	19.5	585	30.0	19.5	30.0	2050	4.44	56.5
"	T-12	20	24.5	900	36.8	24.5	36.8	1650	3.65	113.9
"	T-8	30	40.0	1440	36.0	37.25	38.6	2475	5.47	113.9
"	T-12	40	53.0	2120	40.0	48.75	43.4	1750	3.87	227.0
Bl.†	T-10	85	100.0	5000	50.0			3600	10.0	200.0
Color										
Daylight					6500° Kelvin			2500 Hours		
White					3500° Kelvin			2500 Hours		
G. E. Cooper Hewitt Blue White								3000 Hours		

Note: * 118 Volt Equipment † G. E. Cooper Hewitt Lamp.
 "Lumens" and "L. P. W." (lumens per watt) rated at end of first 100 hours burning and operating in room temperature of 80° fahrenheit. Output will be decreased materially at temperatures well above or below this point.

INCANDESCENT AND MERCURY LAMPS

In comparing efficiencies, the fluorescent L. P. W. should be matched with the largest size incandescent lamp which would be used, not with comparable wattage sizes.

Total Watts	Type	Lumens	Overall L. P. W.	Life
15	Med. I. F.	141	9.4	1000 Hrs.
25	"	262	10.5	"
40	"	468	11.7	"
60	"	834	13.9	"
75	"	1117	14.9	750 Hrs.
100	"	1620	16.2	"
150	"	2610	17.4	"
200	"	3680	18.4	"
300	"	5910	19.7	"
500	Mog. I. F.	10050	20.1	1000 Hrs.
750	"	14550	19.4	"
1000	"	21000	21.0	"
1500	"	33000	22.0	"
300	Mercury	7500	25.0	2000 Hrs.
450	"	16000	36.6	"

Brightness and Color Temperature

Standard enclosing globe properly lamped—3 —4 Candles per square inch.
 Semi-Indirect properly lamped —1.5—3 Candles per square inch.
 Totally Indirect properly lamped —0 —1 Candles per square inch.

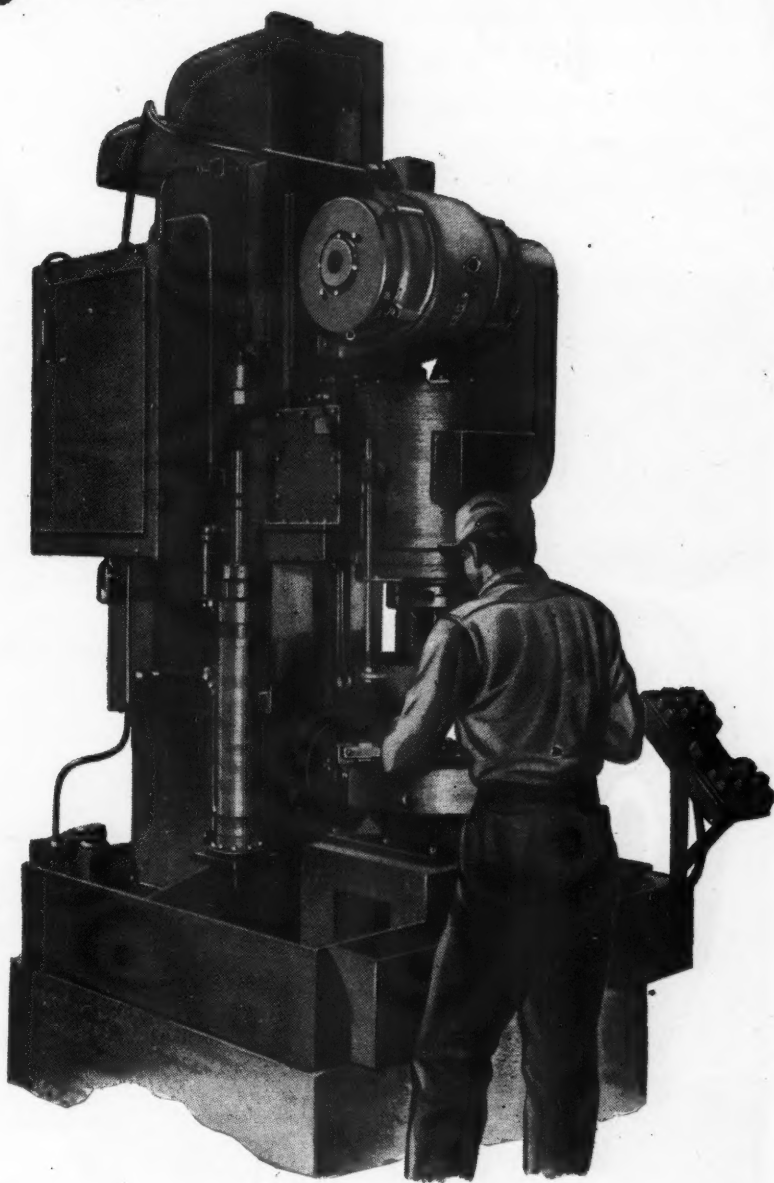
Color—500 Watt Incandescent — 3000° Kelvin.
 Color—500 Watt Incandescent Daylight — 4000° Kelvin.

Compiled by L. B. Paist, Northern States Power Co., Minneapolis, Minn.

SEE FAIRBANKS-MORSE FIRST *FOR* MOTORS

ON countless difficult jobs Fairbanks-Morse Motors have proved their outstanding qualities. However exacting the requirements, however heavy the service, users find that these motors have the efficiency and the stamina that mean economical, uninterrupted power.

You, too, can invest in Fairbanks-Morse Motors with confidence. Fairbanks, Morse & Co., Chicago 5, Illinois.



Fairbanks-Morse

A name worth remembering



Diesel Locomotives • Diesel Engines
Scales • Motors • Pumps • Generators
Magnetos • Stokers • Railroad Motor
Cars and Standpipes • Farm Equipment

*He's as close
as your phone...*



PACEMAKER IN WIRE PRODUCTS

WEATHERPROOF WIRE • SERVICE ENTRANCE CABLES
RUBBER COVERED WIRES AND CABLES (INCLUDING SMALL
DIAMETER BUILDING WIRES AND CABLES) • RUBBER
INSULATED POWER CABLES • TELEPHONE WIRES • BARE
COPPER STRAND • MAGNET WIRE • PIGTAIL AND BRAIDED
COPPER • RUBBER SHEATHED PORTABLE CABLES • TROLLEY
CONTACT WIRE • VARNISHED CAMBRIC POWER CABLES

ROE
ELECTRICAL

with Answers to Many of Your CABLE PROBLEMS

IT'S AS SIMPLE AS THAT. When you're faced with a tough cable problem or wiring job, chances are you'll solve it in less time . . . with less trouble . . . by phoning your nearest Roebling branch office.

A Roebling field engineer is well qualified to analyze and advise on unusual wiring needs. He can tell you what performance to expect of each type wire or cable . . . what's available right now . . . what's likely to be on hand soon . . . what can be specifically recommended to meet the operating conditions.

Maybe he can even answer your problem by phone. But in any event, he's always ready to come out to the job and offer helpful suggestions first-hand. Add his specialized knowledge of wires and cables to *your* knowledge of the job's requirements . . . and the result is a simple short-cut to long, efficient cable performance.

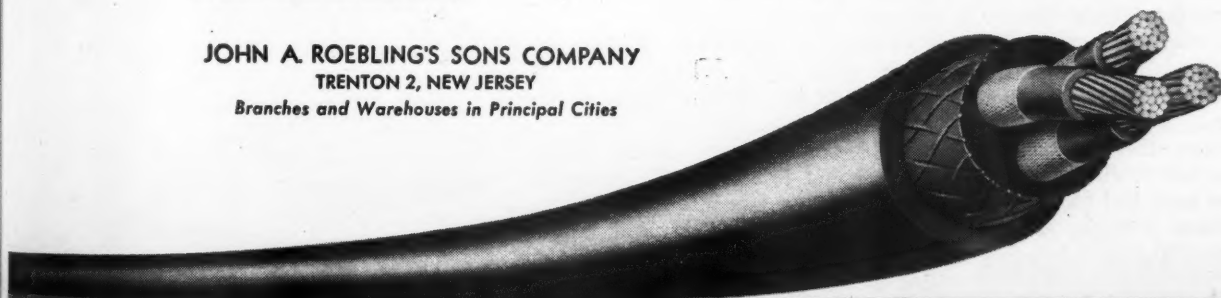
Roebling field engineering service is *dependable* . . . and doesn't end with an order. Ask us about it.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

YOUR ROEBLING FIELD ENGINEER IS ALWAYS READY TO SERVE YOU . . .

Atlanta, Ga.	934 Avon Avenue
	Raymond 2151
Boston 10, Mass.	51 Sleeper Street
	Lib. 4373
Chicago 6, Ill.	600 W. Jackson Blvd.
	Rand. 1971
Cleveland 14, Ohio	701 St. Clair Ave., N.E.
	L.D. 249 & Main 5030
Denver 17, Colorado	1635 Seventeenth St.
	East 2684
Houston 1, Texas	6216 Navigation Blvd.
	Woodcrest 6-8316
Los Angeles 54, Calif.	216 S. Alameda Street
	Trinity 1261
New York 6, N.Y.	19 Rector Street
	Wh 3-5200
Philadelphia 7, Pa.	12 S. 12th Street
	Market 2751
Pittsburgh 12, Pa.	855 W. North Avenue
	Fairfax 2766
Portland 9, Ore.	1032 N.W. 14th Avenue
	Broadway 5456
San Francisco 1, Calif.	1740 17th Street
	Market 8787
Seattle 4, Wash.	900 First Avenue, South
	Main 4992

KEEP THIS INFORMATION HANDY
FOR FURTHER REFERENCE



BLING



WIRES AND CABLES

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay \$5.00.

READER'S QUIZ

TEST PANEL FOR FLUORESCENT LIGHTS

QUESTION 217—I would like to know the success that readers have had in making a test panel for testing fluorescent lights from the smallest to the 100 watt size. We have a panel in the shop but it is quite bulky and I believe that it could be more compact and yet get a quick test on ballast, lamp or starter and compensator, if separate, and either a high or low-power factor lamp. I would like to see a diagram of such a tester.
—C.S.S.

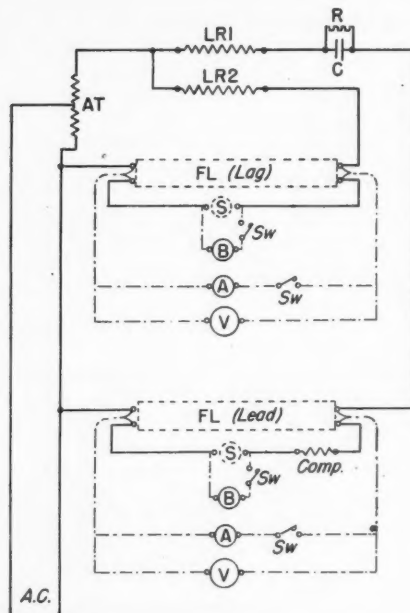
A. TO QUESTION 217—In reply to the question on a panel for testing fluorescent lights, I refer the writer, C.S.S., to the November 1945 issue of *Electrical Contracting*.

In the article by Mr. Harris Reinhardt on page 49, "How to Check Fluorescent Components", there is outlined several test panels for testing fluorescent tubes.

In our shop we made a test panel following Mr. Reinhardt's ideas, and it works very well.

No doubt there are other methods and boards made that will work as well as this board, but we have had fine results and I can recommend it to any shop in need of a fluorescent tube check board.—G.W.L.

A. TO QUESTION 217—A portable fluorescent light tester may be built by assembling a 250 volt voltmeter, two sockets with filament lamps, a double pole switch (optional), an extension cord connected on one side to two old fluorescent lamp bases, another extension cord connected on one end to the two contact pins of a discarded starter from which the glow switch and the capacitor have been removed. These parts are connected and applied as shown. Prior to testing a luminaire, all lamps and starters are removed and the prepared devices are plugged in. In testing 15 to 40 watt fluorescent



lamps, two 40 watt filament lamps are used. The 100 watt fluorescent lamps are tested with two 100 watt filament lamps. The testing procedure is as follows:

NORMAL CIRCUIT: Double-pole switch open. The voltmeter reading should be at least that indicated on the ballast nameplate.

Double-pole switch closed. Both lamps should light with the same dim glow when plugs are inserted in lag circuit. When inserted in lead circuit, check lamp will be dim as before, but lamp B will be dimmer due to the series compensator.

DEFECTIVE CIRCUIT: Zero open-circuit voltage. If neither lamp lights, there must be an open circuit in the lamp holders, ballast, or wiring.

Low open-circuit voltage. A 30, 40, or a 100 watt lamp luminaire requiring 200 to 250 volts utilizes an auto-transformer when used on a 115 to 120 volt circuit. A burnt-out auto-transformer will cause a low open-circuit voltage. This will require the replacement of the ballast in which it is enclosed.

CORRECT OPEN-CIRCUIT VOLTAGE: Lamp A lights brightly and lamp B does not light. In lag circuit,

the starting circuit is open. In lead circuit, the starting circuit including compensator is open. If an open-circuit exists in a built-in type compensator, the ballast must be replaced.

Lamps A and B, connected in the lag circuit, lighting very brightly indicate a short-circuited lag reactor necessitating replacement of the ballast.

Lamp A dim and lamp B dark while connected in the lead circuit indicate a short-circuited lead reactor necessitating replacement of the ballast.

Symbols

LR 1: Lead Circuit reactor in ballast

LR 2: Lag circuit reactor in ballast

AT: Auto-transformer from 110-125 volts to 220-230 volts

R: Resistor

C: Capacitor

FL 1: Fluorescent lamp in lag circuit (removed), 40 W.

FL 2: Fluorescent lamp in lead circuit (removed), 40 W.

S: Starter (removed)

A: Incandescent lamp, 40 watt, 120 volt

B: Incandescent lamp, 40 watt, 120 volt

Sw: Two single-pole or one double-pole switch

V: Voltmeter, 250 volt a-c.

Comp.: Starting compensator.

—R.G.C.

POLARITY TESTS ON TRANSFORMERS

QUESTION 218—What is the procedure in making polarity tests on current (instrument) transformers?—T.B.B.

A. TO QUESTION 218—There are numerous methods of checking the polarity. Where ammeters, voltmeters, wattmeters and/or a rotating standard are available, the check can be made in several ways. If T. B. B. does not have these instruments and has one current transformer with a known polarity, he can compare others of the

These Wagner Motors HAVE BUILT-IN PROTECTION

Wagner motors that have built-in protection by virtue of their design and construction give dependable service year after year under operating conditions which would necessitate frequent shutdowns and replacements if ordinary motors were being used.

It pays to use Wagner protected motors in locations where dust, dirt, moisture, metal filings, chips, splashing or dripping liquids, acid fumes, explosive gases, or other such conditions would cut short the life of ordinary motors.

There is a Wagner protected motor specifically designed to meet the special conditions found in machine shops, chemical plants, refineries, and other manufacturing and processing plants. Four types of Wagner protected motors are shown at the left and described below.

1 WAGNER SPLASH-PROOF MOTORS

are built to operate dependably in locations where they are subject to splashing water, oil, or other liquids. They are widely used in exposed outdoor locations, and are completely self-protected against ice, sleet, snow, and rain.

2 WAGNER EXPLOSION-PROOF MOTORS

have been approved by the Underwriters Laboratories for Class I Group D hazardous locations, "where gasoline, petroleum, naphtha, alcohols, acetone, lacquer solvent vapors, or natural gas are manufactured, used, or handled."

3 WAGNER TOTALLY-ENCLOSED FAN-COOLED MOTORS

are designed to operate under severe and adverse conditions in locations where dust, dirt, abrasives, steel chips, filings, acid fumes, and other harmful elements may damage the windings and bearings.

4 WAGNER TOTALLY-ENCLOSED NON-VENTILATED MOTORS

may be installed in the locations listed under item 3, and are built instead of totally-enclosed fan-cooled motors in the smaller ratings where special provision for cooling is unnecessary. In the larger ratings they are used where the draft produced by the fan-cooled motor is objectionable.

Write for Bulletin MU-185 addressing your request to
Wagner Electric Corporation, 6413 Plymouth Avenue,
St. Louis 14, Missouri, U. S. A.

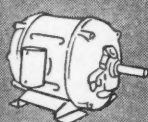
M46-13

Consult Wagner Engineers on all Electric Motor Problems

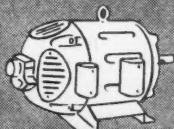
Electric Motors • Air
Brakes • Brake Lining
Hydraulic Brakes

Wagner

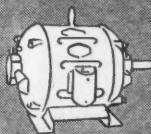
Transformers • Indus-
trial Braking Systems
NoRoL • Tachograph



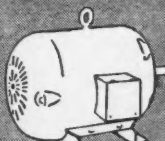
General-Purpose
Motors



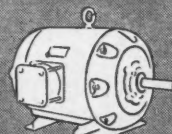
Wound-Rotor
Motors



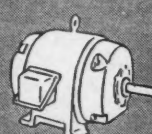
Multispeed
Motors



Totally-Enclosed
Fan-Cooled Motors



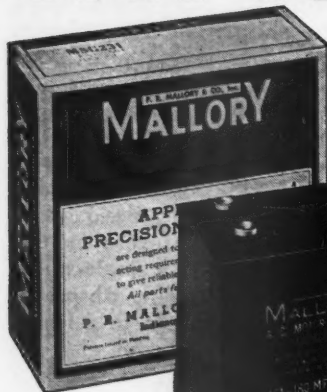
Explosion-Proof
Motors



Splash-Proof
Motors

Sales and Service Branches: ATLANTA 3 • BALTIMORE 18 • BOSTON 15 • BUFFALO 8 • CHICAGO 16 • CINCINNATI 10 • CLEVELAND 15 • DALLAS 1 • DENVER 2 • DETROIT 2
HOUSTON 2 • INDIANAPOLIS 4 • KANSAS CITY 8 • LOS ANGELES 15 • MEMPHIS 3 • MILWAUKEE 2 • MINNEAPOLIS 4 • NEW YORK 7 • OMAHA 2 • PHILADELPHIA 8 • PITTS-
BURGH 13 • PORTLAND 9 • ST. LOUIS 3 • SALT LAKE CITY 1 • SAN FRANCISCO 3 • SEATTLE 4 • SYRACUSE 2 • TULSA 3 • WASHINGTON 5 • In Canada: WAGNER ELECTRIC AT
LEASIDE, ONTARIO—Wagner motor parts are available at 350 Wagner-owned and -contract repair shops.

DEPEND ON—INSIST ON— P. R. MALLORY & CO., Inc. MALLORY CAPACITORS



Necessary leads, lugs, screws, and nuts are included in each box for any type connectors.

Mallory MSG Capacitor:—Small, compact AC Motor Starting Capacitor that fits almost every mounting bracket or box. Replaces rectangular capacitors with leads, lugs or studs. Each capacitor is packed with complete set of universal mounting hardware and installation instructions.



Mallory Type "P" Capacitor:—Plastic case overcomes moisture absorption problems, and provides maximum insulation. May be used to replace cardboard insulated aluminum-case capacitors. Splash-proof plastic end cap and simplified "snap on" mounting bracket available when capacitor is used as original equipment.

Distributed by
INSULATION AND WIRES INCORPORATED

SAINT LOUIS 3, MISSOURI

BOSTON 20, MASS. DETROIT 2, MICH. ATLANTA 3, GA.
HOUSTON 2, TEX. BLUEFIELD, W. VA. NEW YORK 7, N. Y.

SITTLER COMPANY
CHICAGO 7, ILL.

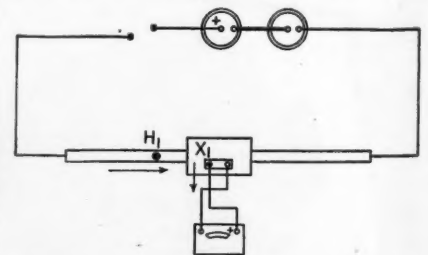
H. A. HOLDEN, INC.
MINNEAPOLIS 3, MINN.

TRI-STATE SUPPLY CORPORATION
LOS ANGELES 13, CAL. • SAN FRANCISCO 7, CAL. • SEATTLE 4, WASH.

same capacity with it. Apply a variable voltage to the secondary winding in parallel and then try to parallel the primary windings. When they parallel without a spark, the marks can be made on the unknown transformer to correspond with the known one. All that is necessary in this test is to see that less than normal (5 amps usually) current flows in the secondary winding; of course, if the primary shows a snappy spark you will naturally have a momentary overload on this secondary winding. Keep in mind the turn ratio of the windings for safety.—E.J.K.

A. TO QUESTION 218—Instrument transformers are so manufactured that the leads are properly identified. One lead of both primary and the secondary coils are plainly marked to indicate that when the current is flowing into the transformer through the marked PRIMARY lead, the coil relationship is such that the current is leaving the transformer through the marked lead of the SECONDARY. This identification should be sufficient for polarity tests or checking before connecting the transformer to a multi-coil instrument such as a wattmeter.—W.R.S.

A. TO QUESTION 218—A simple method of checking the polarity of current transformers, especially applicable to field checks, is to connect a small battery to the primary terminals through a make and break switch as shown on accompanying sketch. Then



connect a D'Arsonval (permanent magnet) type, low reading, d-c voltmeter to the secondary terminals. The voltmeter connection should be made so that the pointer will receive an 'up-scale' impulse at the instant the battery switch is closed, and a 'reverse' impulse at the instant the switch is opened.

The standard polarity marking is then made by placing (H₁) on the primary terminal having the battery positive connection. The secondary terminal that is connected to the voltmeter positive terminal is marked (X₁).

The instantaneous direction of current flow in the primary and secondary circuits is indicated by the arrows.—H.A.W.

A. TO QUESTION 218—Whenever a current transformer is brought into our shop, we first test it for polarity on a test panel I have sketched. We use the polarity marks on

DON'T TAKE CHANCES! THESE PRODUCTS PREVENT TROUBLE...



ESSEX WIRE... *There Is No Better Made!*

Essex makes the kind of wire every shop wants and needs — soft **MAGNET WIRE** with tough, high quality insulation — formvar, enamel or fabric — and **PB300 LEAD WIRE** — the lead wire for motor repair shops — flexible and easy to use.

Made to stand up under your baking varnish treatment without harm — incorporating every latest technical development to improve both wire and insulation — **ESSEX WIRE** meets the toughest requirements for top quality and service.

Shipment can be made from warehouse or factory stocks.

Send for Complete List and Prices



FIBERGLAS INSULATION MATERIALS

... Guarantee Dependable Jobs!

FIBERGLAS INSULATION prevents motor burnouts and failures — is not affected by moisture — will not burn on overloads or high heat — cannot be attacked by most acid or vapors — will stand up under tough use — takes abuse longer without failure — has great mechanical strength and high dielectric qualities — is thin, light and flexible — saves space and is easy to handle in tight spaces.

Use **FIBERGLAS** for all your best work — satisfy your most particular customers — make all your jobs safe against failures.

FIBERGLAS is carried in stock in tape, tubing, sleeving, cord, cloth and mica combinations.

Write For Samples and Prices



U-WEDJ * FIBRE ARMATURE WEDGES

... With the Perfect Shape!

IWI "U" Shaped Fibre Slot Wedges — **U-Wedges** — give you the best possible protection against electrical and mechanical troubles and failures.

Formed to fit the motor slot perfectly, **U-Wedges** protect and hold windings firmly in place — won't turn over in the slot — slip over both sides of the slot cell insulation — and permit windings to be placed closer to the top of the slot.

U-Wedges are made of the finest fish paper — are easy to handle and use — come in standard 48" lengths or 250 ft. bundles — and do a swell all-round job! Try **U-Wedges**!

Write for Free Sample Set, Mounted, Ready to Use

*Trade Mark Reg. U. S. Pat. Off.



INSULATION AND WIRES INCORPORATED

2127 PINE ST. • ST. LOUIS 3, MISSOURI

BOSTON 20, MASS. DETROIT 2, MICH. ATLANTA 3, GA.
HOUSTON 2, TEX. NEW YORK 7, N. Y.

Send
for Your Copy
of the IWI
Blue Catalog.

PRECISION Electric Motor Bearings



Catalogue

76 Pages, completely illustrates the most complete Bearing Service available. It's FREE.

Johnson E M Bearings rate tops with motor repair men because they are RIGHT in every respect. Every bearing in the line . . . over 250 items . . . is made to the same precise standards as original equipment. Reasonably good delivery can now be made from stocks conveniently located. The next time you need bearings—specify Johnson E M.

JOHNSON BRONZE
SLEEVE BEARING HEADQUARTERS
490 S. MILL STREET NEW CASTLE, PA.

EACH TRICO A CHAMPION

Each TRICO PRODUCT illustrated is "tops" in its field. Each is famous for its proven dependability and "know how" engineering that assures lowest maintenance costs, maximum protection against unnecessary shutdowns, lost man-hours, replacements and repairs.

Users of TRICO FUSES and Accessories, Automatic Oilers and Air Guns know they are steps ahead in being able to produce MORE—FASTER—BETTER—and at LESS COST!

There's no substitute for quality and performance. Make sure you get both . . .

ORDER



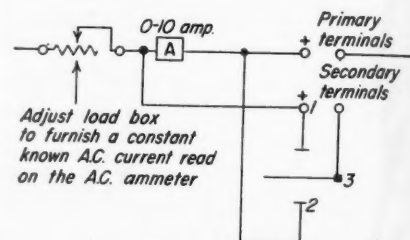
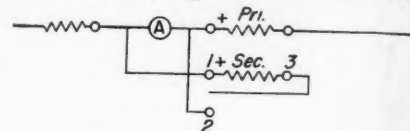
TRICO FUSE MFG. CO.
MILWAUKEE 12, WISCONSIN

the transformer until tested. If we find them correct, the transformer is painted, recorded and put in service.

If polarity marks are wrong, we change or correct the marking, make or change the record, and the transformer is again ready for service. Following is our test procedure.

With terminal No. 3 connected to terminal No. 1 with a known a-c current flowing in the circuit, read the ammeter. Now connect the terminal No. 3 to terminal No. 2 with the same current flowing in the primary circuit read the ammeter.

If the second reading, terminal 3 in contact with 2, is greater than when No.



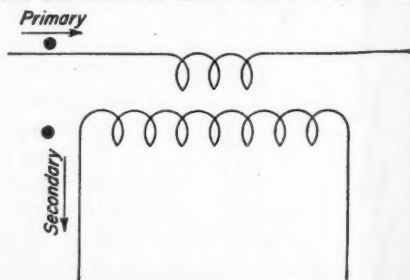
3 was in contact with No. 1, the polarity is correct.

When current is in the primary circuit and no test is being made, keep switch 3 in contact with secondary terminal No. 1.

Current transformer is connected to Pri. and Sec. terminals as marked on board.—G.W.L.

A. TO QUESTION 218—There are no polarity tests for instrument transformers that I know of. The following may be of help to you.

Primary and secondary windings of the transformer are marked with white



and red dots. If the instantaneous direction of the current in the primary is toward the dot, then the current will be away from the dot on the secondary.

If your instrument seems to be off on its reading, reverse the secondary, being sure to do one of two things first—either kill the primary circuit or short-circuit the secondary before disconnecting the instrument.—W.J.F.

A. TO QUESTION 218—With current transformers the sec-

LOOK TO THE FUSE LEADER FOR PRODUCTION PROGRESS



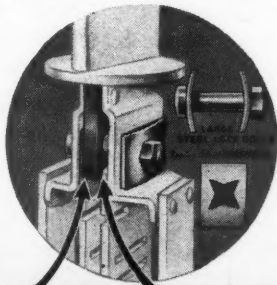
Cool Facts No. 3

NON-HEATING CONTACTS

The wide contact surface maintains low contact resistance.

Spring tension on links locked into position, prevents loosening of contacts, which causes over heating.

Connections held firm by large arched spring steel washers and heavy bolts.



LINKS LOCKED INTO CIRCUIT

APPROVED BY UNDERWRITERS' LABORATORIES

End once and for all times the unnecessary delays—shut downs—interruptions and costly expense resulting from out-of-date fuses.

Modern science has developed the coolest operating fuse in the WARE HI-LAG—the SAFE—ECONOMICAL and FOOLPROOF Fuse, giving greatest satisfaction and service with full protection.

The reasons for WARE HI-LAG Super Performance are—higher lag for starting loads and surges—greater strength and durability—link designed for maintaining low resistance—non-heating, spring tension contacts with greater contact area. These are features which save time, expense and renewal costs. Start economizing! Try WARE HI-LAG Today!

Write for Brochure giving details of all the COOL FACTS, sizes and prices.

WARE *Brothers* 4450 W. LAKE ST. · CHICAGO 24, ILL.

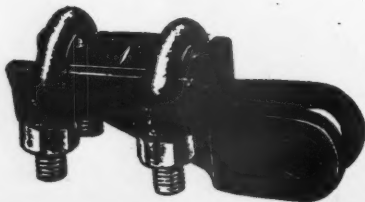
"EFFICIENCY" DEVICES FOR CONDUIT AND CABLE SUSPENSION



Clamps available in three sizes for Cable diameters of 1/10 to 1,500,000 cm.

EFFICIENCY CABLE STRAIN-CLAMP

... Stands Direct Pull of over 17,000 lbs. before cable slips!



By actual test, the EFFICIENCY Cable Strain Clamp will withstand a direct pull of over 17,000 pounds without permitting the cable to slip. This powerful grip results from the EFFICIENCY Clamp's "H" design, incorporating a high ridge across the center of the cable channel and a U-bolt at each end.

Adaptability to all requirements is provided in the EFFICIENCY Clamp's alternate construction . . . which may be clevs or eye, according to your requirements. Both styles are furnished for A.C. or D.C. service.

Write today for your copy of EFFICIENCY Catalog No. 38A . . . contains complete construction and application data on all EFFICIENCY Devices.

Efficiency
ELECTRIC AND MANUFACTURING CO.



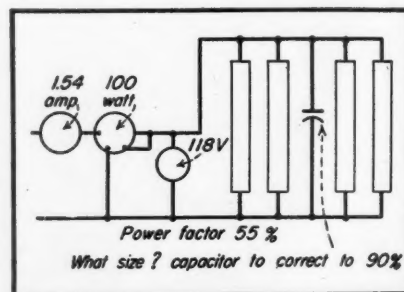
MANUFACTURERS OF EFFICIENCY
ELECTRICAL DEVICES FOR CONDUIT
WIRE AND CABLE SUSPENSION

ondary must never be open-circuited, therefore only current (not voltage) measurements can be made. Best connect a d-c ammeter in the secondary and observe the direction the needle deflects when a d-c voltage (1½ volt dry cell) is applied to the primary. By comparing the direction of the momentary deflections on the different c.t.'s, the polarity is established.—S.V.H.

Can you ANSWER these QUESTIONS

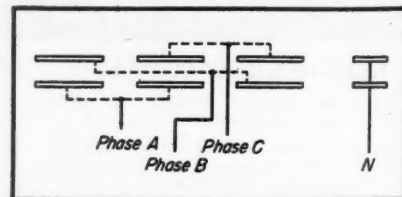
QUESTION X9—Can any reader tell me the formula for figuring the size capacitor in microfarads for correcting the power factor of low power factor ballasts in fluorescent light circuits; one, two or three light ballasts.

For example, I have a store with four single tube fluorescent lamps with four



ballasts wired on one switch. They are low power factor ballasts, I assume about 55 percent. How can I correct to 90 percent?—O.A.T.

QUESTION Y9—I recently installed some 2000 ampere, 3 phase, 4 wire bus duct. It consisted of two bars of ½ inch by 4



inch copper per phase and two bars of ½ inch by 2 inch for the neutral.

The bars were factory connected as shown in sketch by dotted lines. Can someone tell me why they were so connected?—W.H.M.

QUESTION Z9—Will some reader kindly give the formulas or step-by-step procedure used in the design of a-c air core solenoids? By air core I refer to a coil having no magnetic material other than its plunger.

I am familiar with the turns-per-volt method, but I am not fully satisfied with the overall efficiency of a coil designed in this manner.—T.B.B.

PLEASE SEND IN
YOUR ANSWERS BY JULY 15

1/8 1/4 1/2 3/4 1 1 1/2 2 2 1/2 3 3 1/2 4 4 1/2 5 5 1/2 6 6 1/2 7 7 1/2 8 8 1/2 9 9 1/2 10

SUPERIOR
CARBON GRAPHITE METAL GRAPHITE
BRUSHES

FRACTIONAL HORSE POWER MOTOR BRUSHES

Ask for
CATALOG
10-A

See Page 74

Ask your local
representative
about Superior
Replacement
Brushes.

This big catalog contains a lot of important information about brushes for fractional horsepower motors. On Pages 78 to 80 you will find the details of six different brush assortments. Also listed are industrial sizes carried in stock for replacement purposes (see Page 74). Catalog 10-A is free, of course. Get your copy today.

SUPERIOR CARBON PRODUCTS, Inc.
9113 George Ave., Cleveland 5, O.



SUPERIOR CARBON BRUSHES

WINDING AND CONNECTING TIME

[FROM PAGE 74]

taping of coil ends. All time is expressed in decimal hours.

With any set of coils there is always a fixed amount of getting ready time that will be practically the same for any rating in the *group* wound range using a single wire. This time covers getting wire and slot insulation ready for work and setting the group winder and the insulation cutter.

If multiple wires are used an additional amount of time is added for each additional strand of wire.

For this discussion we have estimated .20 hour for the single wire time with .15 hour for each additional wire.

The balance of the time can be divided into the following groups:

Group A—Time varying directly as number of slots or coils which includes cutting slot insulation and wedges, resetting turn counter and tying coils. Estimated unit .011 hours.

Group B—Time varying directly as number of groups which includes starting and finishing each group, cutting phase, insulation, and removing groups from machine. Estimated unit .009 hour.

Group C—Time involved in the actual winding of the wire which can be easily calculated for any particular winding machine.

Hours = Turns per coil x Number of coils

Winding mach. RPM x 60

With these four basic time units we can build up the coil and insulation time for any set of group wound coils.

Here are a few examples taken from the 5 hp. ratings previously listed. The figure 104 in the Group C happens to be the fourth speed of one of our winding machines, the others being 35, 52, and 68 RPM. The lower speeds would be used with heavy wire or several wires in multiple.

KT 731

Fixed time	.20 hr.
Additional time for extra wire	.15
Group "A" 36 x .011	.396
Group "B" 12 x .009	.108
Group "C" 18 x 36	.104
104 x 60	.958 hr. or 57½ min.

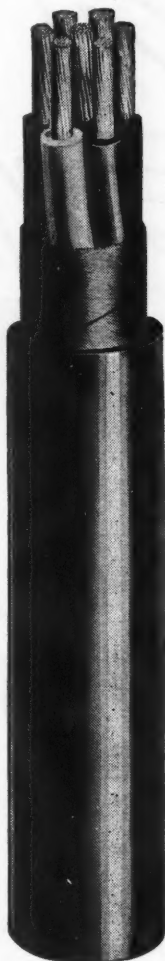
K254-D

Fixed time	.20 hr.
Group "A" 36 x .011	.396
Group "B" 12 x .009	.108
Group "C" 18 x 36	.104
104 x 60	.808 hr. or 48½ min.

CRESCENT

Multi-Conductor Control Cables

WITH
SYNTHOL
INSULATION AND JACKET



Each of the 7 conductors in the CRESCENT Control Cable shown here is insulated with SYNTHOL thermoplastic and the cable assembly as a whole is protected with a SYNTHOL sheath. SYNTHOL is more stable than rubber compounds. It is highly resistant to moisture, oils and most chemicals and will not support combustion.

The individual conductors are color coded for easy identification.

CRESCENT Control Cables are widely used for remote control operation of motors, circuit breakers and other electrical power equipment, and for many types of automatic or supervisory control circuits.

CRESCENT



WIRE and CABLE



CRESCENT INSULATED WIRE & CABLE CO.

TRENTON, N. J.



Synthite **PG-4**

CLEAR BAKING INSULATING VARNISH..

affords exceptional dip-tank stability and ease of application. Applied either by atmospheric dip or vacuum impregnation, this varnish may be cured in conventional gas-fired or infra-red ovens.

Thorough drying and excellent bonding makes PG-4 Clear Baking Varnish highly adaptable for use on high speed armatures. It is extremely well suited for all modern types of coated wire, such as Formvar, Formex, Glass, Nylon, etc. Let us give you further and more complete information on SYNTHITE PG-4 Clear Baking Varnish. Write us today.

*REG. U. S. PAT. OFF.

JOHN C. DOLPH COMPANY
1060 BROAD STREET • NEWARK 2, N. J.

Insulating **Dolph's** *Varnish Specialists*

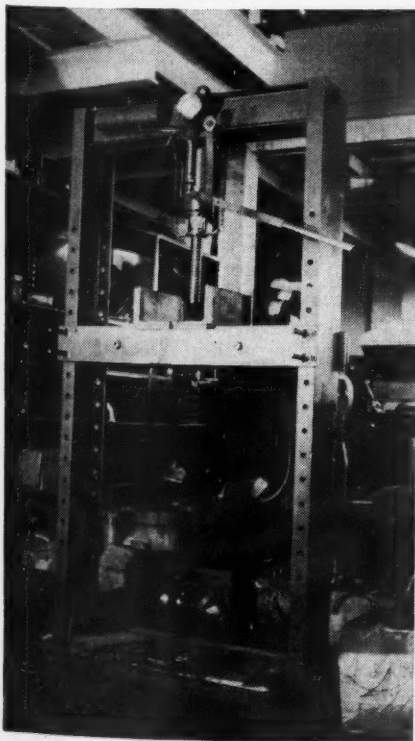
MOTOR SHOPS

EASILY OPERATED 20-TON PRESS

The Buzzell Electric Works, San Francisco, has built a novel 20-ton hydraulic press for pressing out shafts and similar jobs. The cylinder and ram were part of a former press, but aside from that, the outfit cost them only about \$140 for materials and labor.

As seen in the photograph, the verticals are 10-in. by 2½-in. channel; the upper crossbars are 6-in. by 2-in. channel; while the lower, movable cross member which holds the work, consists of two steel plates fastened to the outside of the verticals, each of them being 6-in. wide by ¾-in. thick. This cross member for adjustment of work to plunger is held in position on the verticals by steel bolts through holes in the verticals. These holes are spaced on 3½-in. centers.

The cross plates are raised or lowered, to make settings, by chains running inside the vertical channels. A shaft runs from vertical to vertical between the upper channels. This is turned to raise or lower the plates by a chain operated by a hand crank, shown on the right hand vertical, with a



Hydraulic press for pressing out shafts has capacity of 20 tons.

ratchet and about one to two reduction gears, also inside the channel.

The cylinder and hand hydraulic mechanism, with its 11-in. by 5-in. O. D. cylinder, auxiliary cylinders, plunger, etc., were originally built by Buzzell Electric Works.

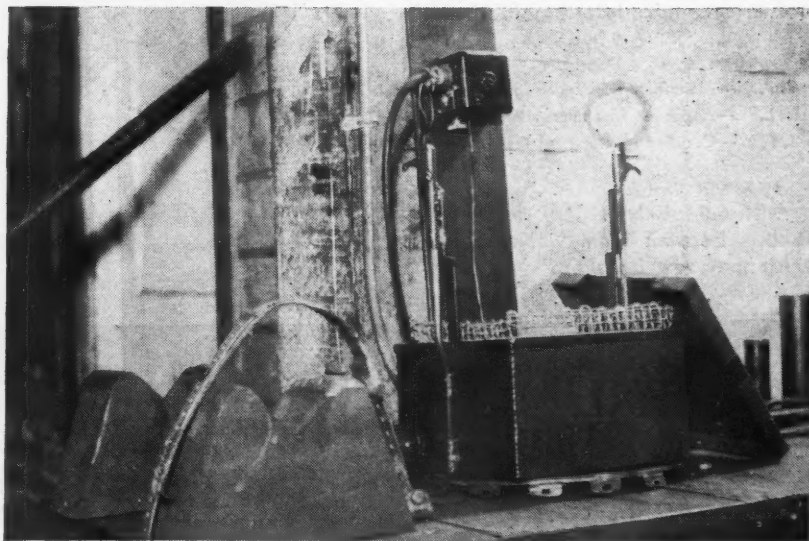
HEATER FOR BALL BEARINGS

Whenever it is necessary to remove ball bearings from an armature shaft and replace them, it is highly desirable that they be first cleaned thoroughly and then warmed, so that they will slip back into place easily, with no hammering or forcing, so that they will be perfectly true.

Having a large order involving many bearings, Kuckel & Sievers, of San Francisco, designed and assembled this thermostatically controlled oil heating bath.

The oil in the square tank is electrically heated and maintained at any desired temperature by the thermostat. A wire basket holds the bearings in the bath. It is designed so that it can be raised out of the bath and held there by dogs, fitting over the ends of the upright rods, to drain the bearings when sufficiently heated.

At the left are two V-locks for holding the shaft so that the bearings can be removed, cleaned, warmed, and replaced at one location.



Ball bearing heater with thermostatic control.

SMALL GADGETS AND TIME SAVERS

A number of gadgets which can be put into use with little or no cash outlay were described at the NISA Convention, Tampa, Florida, April 8-11, by Wm. H. Braunlich of the Braunlich-Roessle Company, Pittsburgh. Most of these gadgets or time saver methods can be used so often, he pointed out, that a small amount of time saved many times will effect considerable savings in the final cost.

Here are the ideas as given:

1. How many of you have seen the handy twine knife, made by the Handy Twine Knife Co., Upper Sandusky, Ohio? It sells for 25 cents in several sizes and fits on the finger. It is a small ring band with a curved knife cutter and is most convenient in cutting cord when tying up coils or in any similar operation.

2. Have you tried reversing the direction of one of the wire brushes on your wire stripper? They usually run in opposite directions and have a tendency to draw the wire into the machine. If they both run in the same direction you can move the wire in and out with little effort and they seem to remove the insulation just as well.

3. In testing a-c stators it has been found that an open, short, reversed coil or reversed phase will cause an ordinary steel ball to stop or slow down if it has been placed in the stator and caused

3 LABELS TO LOOK FOR ON FLUORESCENT LAMP BALLASTS



When a label is familiar to a buyer, it is usually because the organization so identified is long-established in its particular field.

Chicago Transformer ballasts can boast of three such labels—the C.T.C. emblem, a trademark of manufacturing experience, plus the U.L. and E.T.L. insignias, trademarks of two recognized testing laboratories.

C. T. C.—Manufactured by Chicago Transformer.
U. L. —Approved by Underwriters Laboratories.
E. T. L.—Certified by Electrical Testing Laboratories.

... Three labels to look for on fluorescent lamp ballasts, because ballasts bearing them win confidence for the lighting equipment in which they are installed.



CHICAGO TRANSFORMER

DIVISION OF ESSEX WIRE CORPORATION

3501 ADDISON STREET • CHICAGO, 18

to run around inside the bore by connecting the stator to the voltage for which it has been wound. A ball bearing mounted on a short handle can be substituted for the ball in testing larger stators.

4. If a polyphase motor is connected to the line and started and then one leg opened and an ordinary carbon lamp connected in series in this leg with the power remaining on, the lamp will flicker according to the bad bars in the rotor. This is said to be very effective.

5. By attaching a small metal strip on which are marked graduations numbered the same as the steps on a Potter or similar type fractional head to the stationary leg of a set of inside calipers it is possible to set the calipers to the span between two slots of a stator and read the proper setting for the head on the scale on the calipers. A small pointer attached to the movable leg of the calipers gives this reading on the scale.

6. Rolling or moving reels of wire from one place to another is a nasty and unhandy every day job. With a handle similar to the one you have on your lawn roller except that it is left open on one side so that you can readily slip the axle into the reel from one side, you can roll the reel without breaking your back and with control of direction which the present foot method does not command. A rod $\frac{1}{8}$ -inch or $\frac{1}{4}$ -inch in diameter will serve this purpose.

7. Scotch electrical tape can be applied by a hand-cranked edging machine which automatically folds the tape over the edges of slot insulation paper as the paper is rolled through a metal guide. This protective edge prevents windings from cutting into the edges of the cell and increases the dielectric strength. This is an inexpensive device and may be purchased from the Minnesota Mining and Manufacturing Company.

8. If you are not using some form of mandrels in different sizes, each to handle a certain size bearing, for pushing out old bearings and pushing in new ones, here is a place where you can save considerable time, on small motors especially.

9. An ordinary shop growler can be used and very well for heating ball bearings, couplings, gears, commutators and other force-fit objects in order to facilitate their installation on shafts. It is only necessary to make two laminated adapters, triangular in shape, to fit into the open space in your growler so that they can be moved apart far enough so that the bearing or what have you can be inserted between them. For instance, if you are to install a new ball bearing on a shaft designed for a press fit, insert the bearing in its original wrapper in the growler. When the ball bearing has heated to about 160°–180° F., the light grease and paraffin in the wrapper give

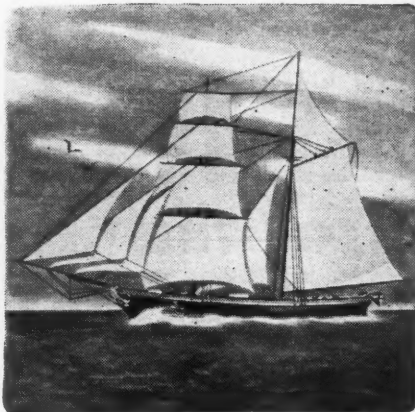


Old Reliable Red Band Says—

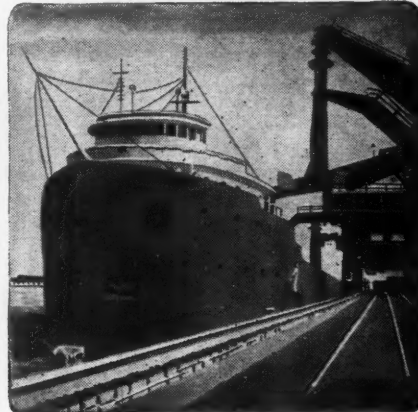
**"Ore used to ride
Piggy-Back!"***



1 In 1855, the first lake shipment of ore reached Cleveland from the iron ranges of Lake Superior. Unloading the cargo of even a small sailing vessel meant four or five days of unremitting toil. The ore had to be carried piggy-back from ship to shore!



2 In the early 1860's, unloading time was cut in half. Men down in the hold shoveled ore into tubs. Teams of horses on the docks pulled up the tubs. With as many as 40 horses, unloading a brig like the 132-ton Columbia, above, required several days.



3 In 1899, electrically operated Hulett unloaders made handling easier, quicker, cheaper. Today, Hulett's empty a 14,275-ton cargo in less than 3 hours. Howell has specialized in motors for material handling and other industrial needs since 1915.

Have you a hard job for Horsepower?

Howell Motors are better than ever today. The reasons: Years of experience in building industrial type motors to meet the exacting requirements of the automotive, machine tool, dairy, food, and other important industries.

Howell Motors are quality-motors. They are smooth-operating because they are statically and dynamically balanced. They are better performing because they are built of

the finest materials—copper or bronze rotors—and completely insulated. They are trouble-free on the job because they are designed for the toughest tasks in industry—consequently, they perform better on all jobs.

For your needs, in specialized or standard motors, phone the nearest Howell Representative. Remember, you pay no more for industrial type Howell Motors . . . but you always get top quality for your money.

**Another historic story by Old Reliable Red Band*



Howell Protected Type Motors available in sizes 5 h.p. and smaller. Also other sizes of Howell industrial type motors available up to 150 h.p.



HOWELL MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.
Manufacturers of Quality Industrial Type Motors Since 1915



KLEINS

...FOR THE MAN ON THE POLE

On emergency jobs . . . on tough jobs . . . on routine jobs . . . the men who string and maintain the nation's power and communication lines rely on Kleins. Wherever you see linemen you'll see Kleins—pliers and wrenches, tool belts and safety straps, climbers and grips.

There's a sound reason for this preference. For linemen and electricians—men who know good tools—also know of the quality materials and expert craftsmanship that go into every piece of Klein equipment. To them this excellence means safety, efficiency, speed . . . on every job.

Today Klein is in production on its complete line of quality equipment. Of course, demand still exceeds supply—but your supplier will furnish the Klein equipment you need just as soon as possible.

ASK YOUR SUPPLIER

Foreign Distributor:
International Standard Electric Corp.,
New York

The Klein Pocket Tool Guide showing the Klein line and containing useful information will be sent on request.



Klein Pliers



Klein-Kord
Tool Belts



Klein-Kord
Safety Straps



Klein Climbers



Since 1857

Mathias KLEIN & Sons
Established 1857 Chicago, Ill., U.S.A.

3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

off a slight haze and the bearing has expanded enough to be dropped on the shaft. The bearing has been kept clean and no damage has been done. Incidentally the bearing manufacturers do not advise heating ball bearings above 212° F. The same principle can be applied to couplings, gears, etc. It is also said that small commutators which have been re-micaed can be set up nice and tight by this method as the heating takes place mostly in the core. The mica softens up from inside and sets easily when the commutator is tightened. Some commutators may be installed by expanding the core by this method.

10. A growler may be used for checking new or reinsulated coils for shorts. If the coil under test is placed over one pole and has a shorted turn it will tend to be thrown off, and in some cases is actually thrown off. Some shops place an ammeter in the growler circuit but this is not necessary.

11. Considerable difficulty has been experienced in holding armatures for dipping and baking vertically. Lathe dogs, chain and many other makeshifts are used to hold armatures. Sometimes they allow the armature to drop causing damage. A method which has proven very satisfactory is to provide steel rings of suitable sizes to slip over the shaft. The hole may be threaded so that the ring will screw on the shaft, if enough of one size are to be dipped and the shaft has threads on the end. Three or four set screws may be provided which can be tightened against a $\frac{1}{8}$ -inch copper strip which has been placed around the shaft. A U-shaped piece of steel should be welded to the top of the ring to allow for a rod or hook to slip through, from which the armature is suspended. Since these clamps are for one purpose only they can easily be kept near the oven.

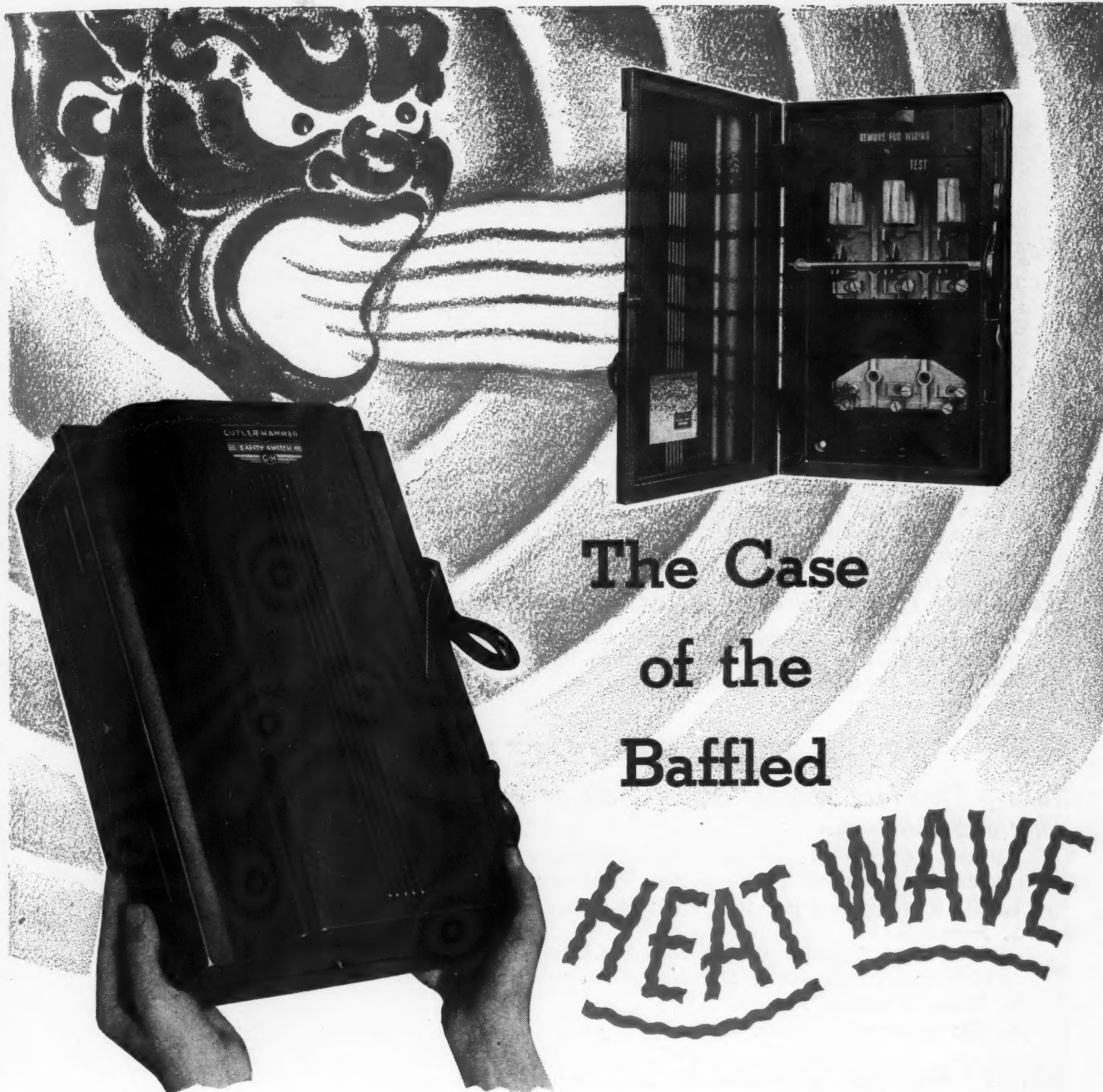
12. If bolts are inserted in the assembly bolt holes before the stators are dipped in varnish, and baked and allowed to remain they may be removed after baking and the threads will be clean and require no further work before assembly.

13. The following method of removing varnish from the inside of stators has saved considerable time. A 2-inch diameter, 1½-inch face rubber mounted arbor on which is slipped an 80 grit abrasive band is used on a flexible shaft grinder and the varnish is removed very quickly.

ROLL-AWAY DIP TANK

Space in the average motor shop is almost always a scarce item. The type of equipment required—bake ovens, spray booths, cleaning booths, dip tanks,

Electrical Contracting, June 1946



The Case of the Baffled

HEAT WAVE

A new high standard of performance has been established by the new Cutler-Hammer Safety Switches. Here is a switch mechanism that will carry its rated load with only nominal heating. Here is a safety switch designed throughout to baffle any heat wave generated by correctly selected fuses.

And finally here is a line

of safety switches engineered to the last detail to provide better appearance, easier installation, greater convenience and safety. As a result this line is being featured from coast to coast by Cutler-Hammer wholesalers . . . by alert contractors everywhere

CUTLER-HAMMER, Inc.,
1306 St. Paul Avenue,
Milwaukee 1, Wisconsin.



Let's Talk About BEARINGS!

Wagner Used Bronze Bearings in 1891.

They were the best bearings obtainable at that time. We continued to use them until the more compact and powerful modern driven machines imposed higher bearing loads on our motors.

In 1927 Wagner Pioneered the Bimetal Bearing Which Permitted Higher Bearing Loads.

This Bimetal bearing had a steel outer shell for strength and a high tin babbitt lining for a superior bearing surface. Destruction tests by belting together two identical motors, one equipped with bronze bearings, the other equipped with Bimetal bearings, showed that the Bimetal bearings resist seizure and operate at lower temperatures than bronze bearings.

World War II Necessitated Increased Research.

Tin became scarce . . . Modern Bronze bearings were again considered but finally a Bimetal bearing having a lining of antimony lead babbitt containing a small percentage of tin was selected for its superior performance.

PROVE IT TO YOURSELF!

Take a Standard Wagner Diamond Bored Fully Finished Bimetal Bearing —

You will find that it is not necessary to line ream or otherwise machine it if you install it in an endplate in the following manner.

1. Use a snug fitting mandrel or motor shaft.
2. Press it in.
Don't beat it in as this usually causes buckling and upsetting of the end of bearing, either of which necessitates line reaming.
3. Assemble motor.
4. The motor will be ready to run.

Bimetal Bearings for Undersize Shafts.

These Bimetal bearings are available unbored for use on undersize shafts within reasonable limits.

They should be line reamed to fit the desired size.

These Bearings Are Available for Immediate Delivery.



Every motor repair shop needs this catalog. It helps you determine the catalog number and price of Wagner fast-moving motor parts. Ask for Catalog MU-40 today.

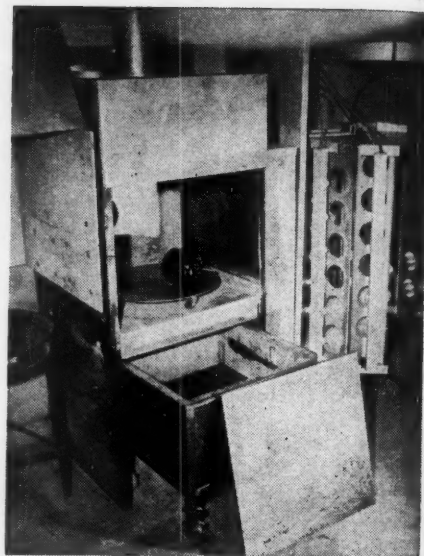
Genuine Wagner motor parts are available at 325 authorized service stations displaying the sign pictured at the left.



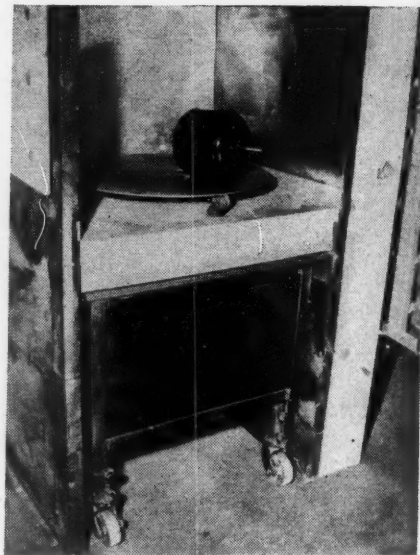
M46-10

Wagner WE Electric

6413 Plymouth Avenue, St. Louis 14, Mo., U. S. A.



Combination spray booth and varnish dip tank at the Electric Service Company shop in Ann Arbor, Michigan. Tank is pulled out and placed near infra-red "oven" at right for dipping operation.



Nestled snugly under the booth, the tank is out of the way when not in use. Note the caster-supported turntable in the booth.

etc.—all take up a good bit of floor area. Every shop owner is constantly trying to arrange his equipment in a manner that will conserve as much floor space as possible.

The dip tank problem was cleverly solved by a unique roll-away tank developed by the Electric Service Company of Ann Arbor, Michigan. Being cramped for space, they built a 26-inch square steel tank, 18 inches deep. The angle iron frame of the unit is mounted on four heavy duty industrial casters that provide mobility and keep the bottom of the tank 12 inches above floor level, a feature that facilitates cleaning the shop floor.

The tank is small enough to be moved to any part of the shop by one man.

Electrical Contracting, June 1946

10,000,000,000 OHMS

for leakage resistance measurements at low potentials



WILL INDICATE:

Insulation Properties

Leakage Resistance

Conductivity of
Insulating Materials

Leakage due to
moisture absorption
and surface moisture

★ **WESTON** (MODEL 799)

INSULATION TESTER

● A compact, one-hand operated Insulation tester . . . range .1 to 10,000 megohms . . . easily read scale . . . test potential less than 50 volts d-c. Ideal for testing electrical components, devices, materials, and new and existing installations. Details from the WESTON representative near you, or write for bulletin.

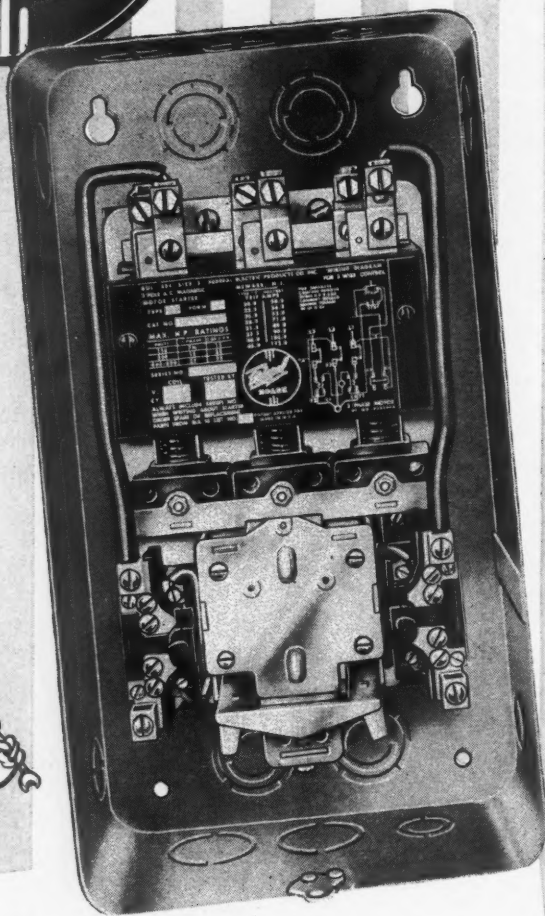
Weston Instruments

Weston Electrical Instrument Corp., 672 Frelinghuysen Ave., Newark 5, New Jersey.

Albany · Atlanta · Boston · Buffalo · Chicago · Cincinnati · Cleveland · Dallas · Denver · Detroit · Jacksonville · Knoxville · Los Angeles · Meriden · Minneapolis · Newark · New Orleans · New York · Philadelphia · Phoenix · Pittsburgh · Rochester · San Francisco · Seattle · St. Louis · Syracuse · In Canada, Northern Electric Co., Ltd., Powerlite Devices, Ltd.,



SIZE 3 MAGNETIC MOTOR STARTER



**For man-size jobs of stop-and-go
Without a bit of care or woe
This starter really fills the bill . . .
A fine example of Federal's skill!**

Sets a new standard of ease and speed in replacement of any stationary or moveable contacts. Coil replacement in a few seconds without disturbing line or load connections. Greater compactness, yet more ample wiring space. Silver contacts on all current interrupting points. Exclusive vertical ball-bearing operation for highest speed solenoid action. Overload relays, combination hand or automatic reset, for dependable protection.

FEDERAL ELECTRIC PRODUCTS COMPANY, INC.

EXECUTIVE OFFICES: 50 PARIS ST., NEWARK 5, N. J. PLANTS: HARTFORD, CONN. NEWARK, N. J.

But the best feature is the fact that it can be pushed under the paint spray booth, out of the way, when not in use. This combination construction of the booth and dip tank solves two major shop problems—it gets the dip tank out of the way and uses the space under the spray booth to the best advantage.

The booth, under which the tank is "stored", is located between the stripping bench and the infra-red bake oven with an air duct connected to a two-speed fan exhausting fumes from each piece of equipment. The 31-inch square booth is equipped with a 24-inch diameter, 1/4-inch sheet steel turntable mounted on a center spindle and resting on three small inverted casters. As the repaired motor is being painted, the turntable is rotated manually.

WIRE SKINNER

A very compact wire skinner has been assembled by the Dahl-Beck Electric Company, San Francisco. It is mounted on a piece of steel plate, bent at right angles, with a base only about a foot square, and the total height is little more than that.

It will be noted in the picture that the two motors are set so that their shafts, carrying the brushes, are at a slight angle, to bring the brushes close together. The angle of one motor can be adjusted by a set screw. The bolt which holds the motor base to the upright back plate travels in an arc slot. This permits pressure between the brushes to be readily varied. The motors are 1/16 horsepower each.



Compact insulation stripper at Dahl-Beck shop in San Francisco uses two 1/16 hp. motors set at a slight angle from vertical with one adjustable. Pressure between brushes is variable. Rig occupies one square foot of bench space and is about one foot high.



What does this Mark mean to you?

Everyone knows that the Virden "V" stands for good value in lighting fixtures... that's an idea that has been accepted straight across the board for many years and sustained by continuous performance. But the Virden "V" also stands, of necessity, for everything that makes the good value possible.

What are some of these things?

Research is one. This embodies analysis of the market from the standpoint of style, measurement of the rhythm and tempo of design; and analysis of the various geographical segments of the U. S. from Maine to California, from the Canadian line to the Gulf, in terms of architectural value, needs, wants.

Styling is another. We have suggested some of the style influences in the preceding paragraph on research. These have to be interpreted in form and pattern by our designing department and there studied from the standpoint of available materials, metals, plastics, glass. The models must then stand up under the four critical tests of: (1) eye appeal;

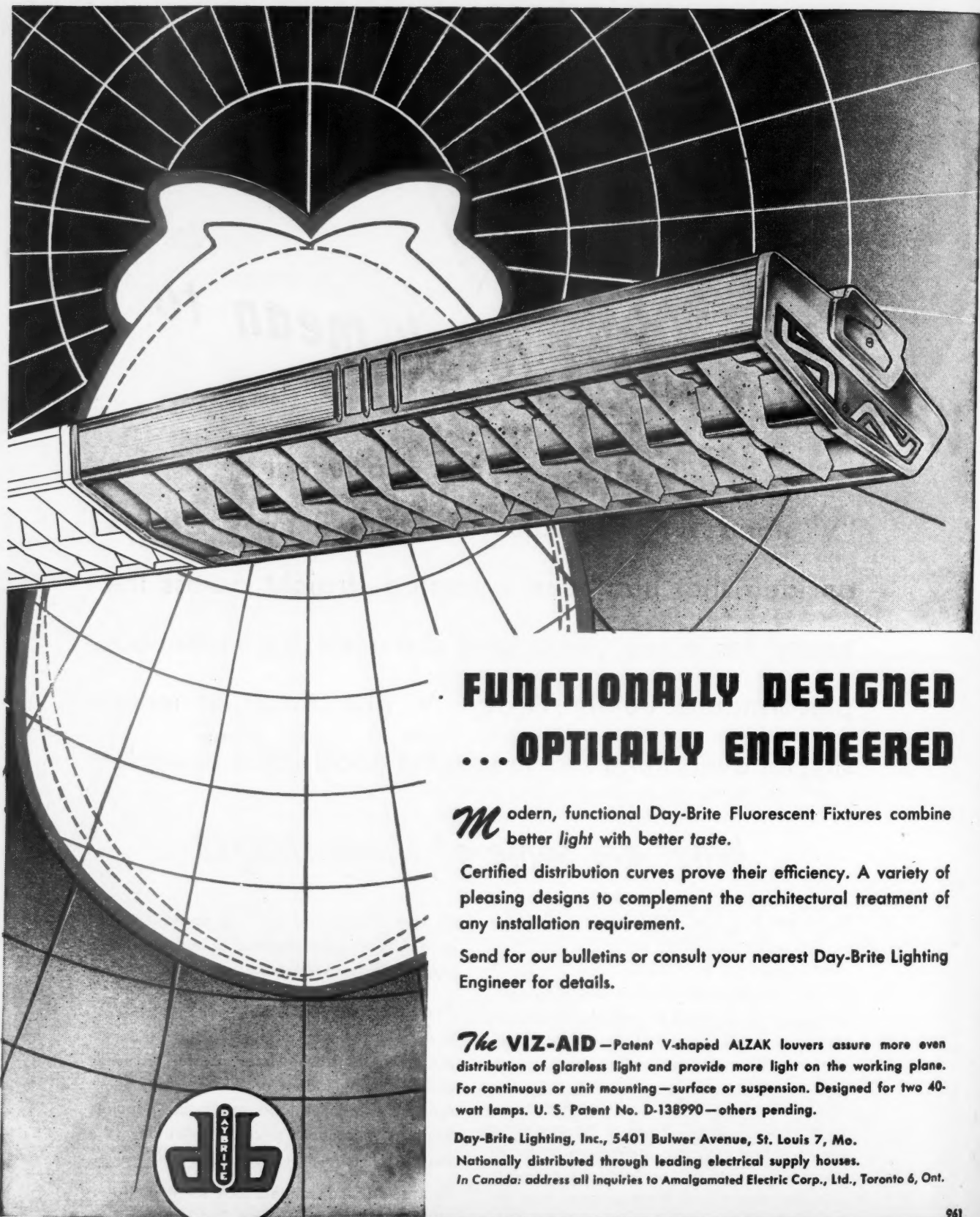
(2) convenience and ease of operation; (3) ease of application—minimum of work in assembly; (4) efficiency in terms of good illumination.

Production. The essence of our business is mass production of high quality lighting fixtures on a basis where careful planning and the most modern production equipment, combine with skilled labor to produce popular items at reasonable prices. The Virden "V" stands for maximum dollar-and-cent value.

Contractors and builders look for the Virden "V" on the package and find its presence there an assurance of complete satisfaction and reliable service.

The John C. Virden Company • Cleveland, Ohio

Member American Home Lighting Institute



FUNCTIONALLY DESIGNED ...OPTICALLY ENGINEERED

*M*odern, functional Day-Brite Fluorescent Fixtures combine better light with better taste.

Certified distribution curves prove their efficiency. A variety of pleasing designs to complement the architectural treatment of any installation requirement.

Send for our bulletins or consult your nearest Day-Brite Lighting Engineer for details.

The VIZ-AID—Patent V-shaped ALZAK louvers assure more even distribution of glareless light and provide more light on the working plane. For continuous or unit mounting—surface or suspension. Designed for two 40-watt lamps. U. S. Patent No. D-138990—others pending.

Day-Brite Lighting, Inc., 5401 Bulwer Avenue, St. Louis 7, Mo.

Nationally distributed through leading electrical supply houses.

In Canada: address all inquiries to Amalgamated Electric Corp., Ltd., Toronto 6, Ont.



IT'S EASY TO SEE WHEN IT'S

DAY-BRITE

Lighting

MODERN LIGHTING

NEW TECHNIQUE FOR PRIVATE OFFICES

By A. W. LARSON

Lighting Engineer, Lighting Division
Westinghouse Electric Corporation
Cleveland, Ohio

For years designing a lighting system for private offices has been a tough problem, while the lighting of a general office seemed relatively simple. Now, with a new technique, the reverse applies.

Through *planned lighting* with respect to office furniture, such as the desk and table, the ideal in quantity and quality of illumination is provided with standard fluorescent luminaires.

The new method, sometimes termed, "Functional Lighting," or "Specific Lighting," meets a fundamental requirement, which is "Provide maximum seeing comfort for the person working at the desk or table." It is a deviation from common practice of adhering to the laws of symmetry in locating luminaires, when there usually is nothing else symmetrical in an office.

Fundamental Considerations

There are three main reasons why private office lighting is difficult:

1. The installation efficiency (utilization coefficient) is low because of the small area. This means it is often impossible to make a symmetrical layout that will provide the desired level of illumination without a "fixture store"

appearance, or excessive wattage and heat.

2. The lumen method of calculation determines the average illumination only and therefore does not give the expected intensity on the desk or table which is of most importance.

3. If a symmetrical layout can be made to satisfy appearance and average footcandle requirements, the cost is often deemed prohibitive. The cost per footcandle per square foot is higher than for a larger general office because of the lower installation efficiency.

Private office lighting has one advantage from the standpoint of luminaire location. That is that the demand for flexibility in locating the desk or table is not as important as for a large general office. Usually there are only a few practical positions where the desk and table can be placed. It is important, however, that they be located to utilize natural light from the windows to best advantage.

From a quality standpoint, private office lighting techniques commonly used today have certain disadvantages. Installation of a single fixture so locates the fixture that its brightness will be reflected from the desk top, paper, pencil-writing and instruments commonly used in offices (Fig. 1). Pictures or glass partitions can also be a source of reflected glare with central location of luminaire. Even where more luminaires are symmetrically spaced to provide a desirable intensity, reflected glare invari-

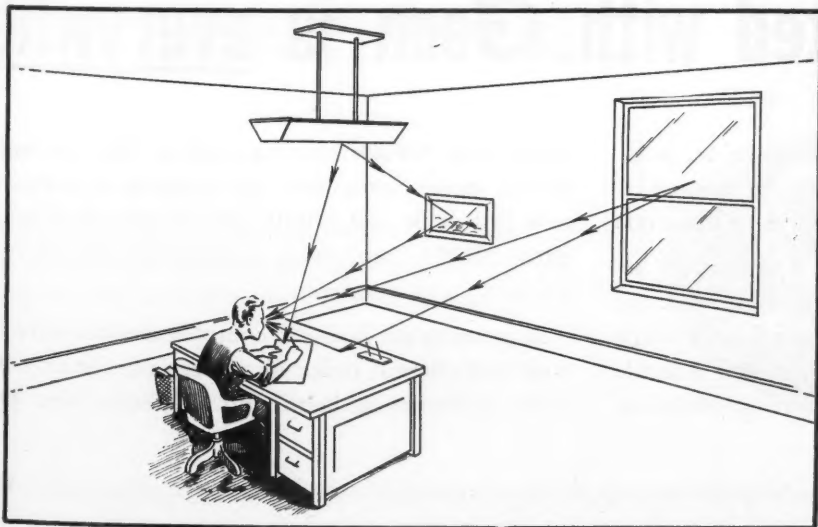


FIG. 1—Reflected images of the luminaire brightness from shiny surfaces cause eyestrain, a common occurrence in private offices and not always fully recognized.

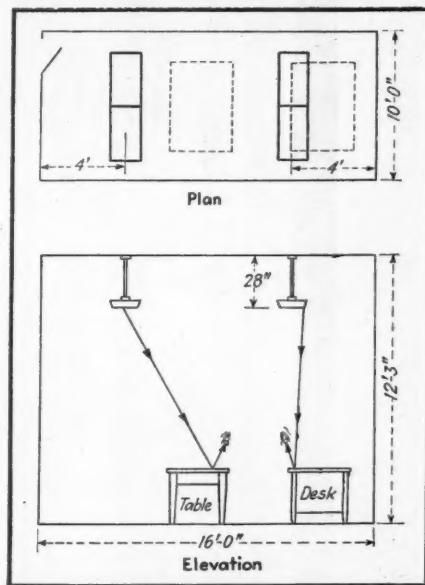


FIG. 2—Four direct-indirect fluorescent luminaires installed as shown would produce 38 footcandles average in-service illumination. Whether working at the table or desk, the eyes will be subjected to constant reflected glare.

ably results, whether working at the desk or table. The requirements then are to eliminate reflected glare by locating the luminaires around but not in front of the person working at the desk or table. Specular images of the luminaire brightness then are reflected away from the eyes of the person sitting at the desk.

The New Technique

For an office 10 feet by 16 feet, four 4-lamp, 40 watt fluorescent luminaires installed as shown in Fig. 2 would provide an average level of 38 footcandles in-service and approximately 63 footcandles initially. With these same four fixtures installed as shown in Fig. 3, the illumination varies as indicated by the "Footcandle Distribution" curve from A to B, Fig. 4. These curves illustrate clearly that the abundance of light is on the table and desk and that the person working at the table (which seems to be a most common occurrence) works under a high intensity and looks into a low graduated intensity when looking across the room. By measurement of this installation, brightness contrast was well within good design, and by observation, no harsh brightness existed in the form of either reflected or direct glare

The smooth surface of insulation made from GEON permits easier installation. Bright NEMA colors aid in quick identification.



Insulated and sheathed with GEON, underground service entrance cable needs no heavy and expensive braid or lead sheathing.



Wire insulated with Geon is everywhere

STARTING with buried service entrance cable, jacketed and insulated with GEON, all the wire used in this modern house is insulated with this modern material.

That's because wire insulated with GEON offers so many advantages—excellent electrical properties, to name one of the most important. Insulation made from GEON is flame resistant; increases safety, reduces fire hazard. Because of its outstanding electrical properties insulation

made from GEON may be used in thin coatings which means more conductors per conduit. It's smooth, too, easy to handle and install; quickly identified because the entire NEMA color range is available. And, of course, it's Underwriters' approved.

As soon as the house is completed, more wire insulated with GEON will make its appearance. It may be in the form of appliance, lamp, and telephone wire. Or it may



Wire insulation made from GEON has, of course, outstanding electrical properties. In addition, its flame resistance greatly reduces fire hazards.

Thinner coatings of insulation, made possible by the use of GEON, permit more conductors per conduit.

in this modern house

be the hookup wire now being used in modern radio sets and other electrical devices.

All of GEON's advantages are available to users in domestic, industrial or utilities wiring. The next time you order wire or cable from your supplier be sure to specify insulation made from GEON. Or for help with specific applications please write Dept. Y-6, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.



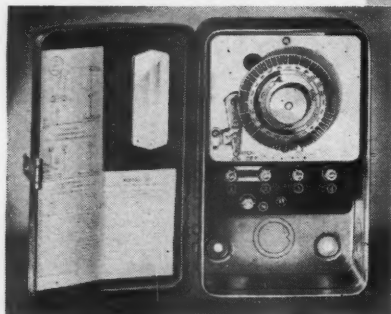
B. F. Goodrich Chemical Company

A DIVISION OF
THE B. F. GOODRICH COMPANY

Electrical Contracting, June 1946

**IT'S
EASY!**

**TO SELL
-install
-operate**



**Paragon
300 SERIES
NOW 10⁷⁵ LIST**



**Telechron
MOTORED
OPERATING
ADVANTAGES**

- 1** Self-starting synchronous operation.
- 2** Complete self-oiling lubrication by patented capillary oiling system.
- 3** Years of continuous, uninterrupted operation.
- 4** Practically instantaneous self-starting at full rated load . . . and other advantages.

300 Series Paragon Time Switches are well known. By the tens of thousands . . . installed in every state and abroad . . . they have made friends through dependable performance . . . have done it for over twenty years. Attractively priced. Widely advertised.

They reduce costs and save valuable man hours through their "Stop Watch" accuracy in controlling ON and OFF time operations on signs, commercial lights, attic fans, stokers, oil burners, blowers, pumps, valves, motors, etc.

Now include many improvements, one of which is the Telechron motor. Easy to install and set. Requires practically no service. Positively not affected by dust. Highest type of design and construction. Offered by progressive supply jobbers at generous trade discount. Write for Complete Catalog.

**PARAGON ELECTRIC COMPANY
1614 TWELFTH STREET
TWO RIVERS, WISCONSIN**



**"Mr. TOPS"
Paragon
Symbol of
Top Quality**

**Paragon Two Rivers
WISCONSIN**

BUILDERS OF ELECTRICAL EQUIPMENT . . . SINCE 1905

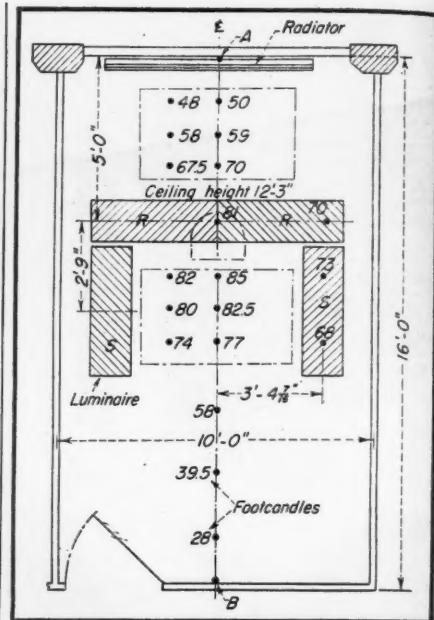


FIG. 3—To eliminate reflected glare the luminaires should be around but not in front of the person working at the desk. Note that the maximum intensity is at the location of the table and desk.

REFLECTION FACTORS

Ceiling (white)	80%
Top of side walls (21" from ceiling)	80%
Dado (medium green) (42" from floor)	35%
Balance of walls (light green)	65%

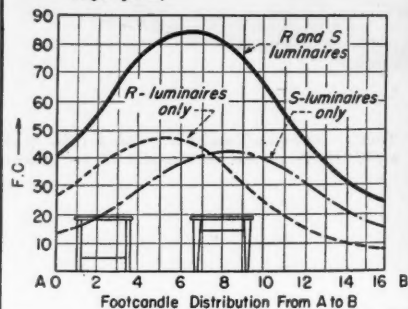


FIG. 4—Above data applies to office shown in Fig. 3. After lamps had burned 1000 hours, footcandle values indicated were measured. Four direct-indirect luminaires, each equipped with four 40 watt white lamps, were suspended 28 inches overall from ceiling.

as viewed within normal viewing angles.

After 1000 hours of burning, the average illumination from A to B (Fig. 3) was 57 footcandles. This compares favorably with the calculated initial average level of 63 footcandles, however, the intensity at the table was 85 footcandles, even after 1000 hours of burning. This exceeds the average by 49 percent, which is acceptable since the brightness contrast of the surroundings are well within accepted practice. The brightness of the walls is more important than the footcandles on the horizontal plane between the table and the wall.

Many layouts are possible which will

PITTSBURGH PERMAFLECTOR LIGHTING EQUIPMENT



IT'S EASY TO SEE . . .

Something Better Has Come to Light

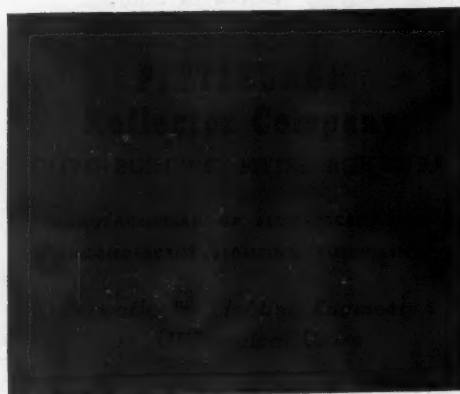
Yes! Something *better* . . . and more profitable . . . lighting equipment which you can talk about and *sell*! For *Pittsburgh Permaflector* Fluorescent and Incandescent Lighting Equipment—scientifically correct and distinctive in appearance—fits into every plan and creates *exactly* the desired illuminating effects.

Many things contribute to *Pittsburgh Permaflector* leadership: sound engineering, good styling, fine craftsmanship . . . and these desirable qualities make sales. Take stock of the opportunities *Pittsburgh Permaflector* offers you. Write for details on this highly-profitable, favorably-accepted, prestige line of fluorescent and incandescent lighting equipment.

"THERE IS A PERMAFLECTOR FOR EVERY PURPOSE"

PITTSBURGH PERMAFLECTORS ARE DISTRIBUTED BY BETTER ELECTRIC WHOLESALERS EVERYWHERE

Electrical Contracting, June 1946





RLM Heavy Threaded Deep Bowl Reflector and Socket Hoods



RLM Threaded Dome Reflector



• QUAD Units have proved themselves in long-time service. Contractors enthusiastically endorse them because they live up to their claims—they give good lighting efficiency for long periods and require little attention. Install QUADS for industrial or commercial installation indoor or outdoor. Good business is the result. Quad . . . for today and for tomorrow.



Manufacturers of Incandescent Lighting Equipment

QUADRANGLE MFG. COMPANY

32 S. PEORIA ST.
CHICAGO 7 ILLINOIS

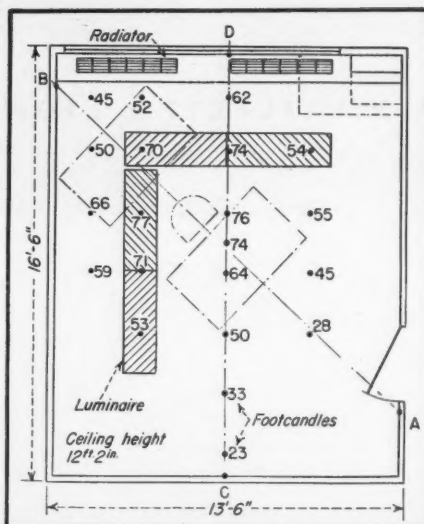


FIG. 5—An ideal lighting layout for an office is the "L" design. The average illumination from A to B in this office is 48 footcandles, while at the desk and table the intensity is over 70 footcandles.

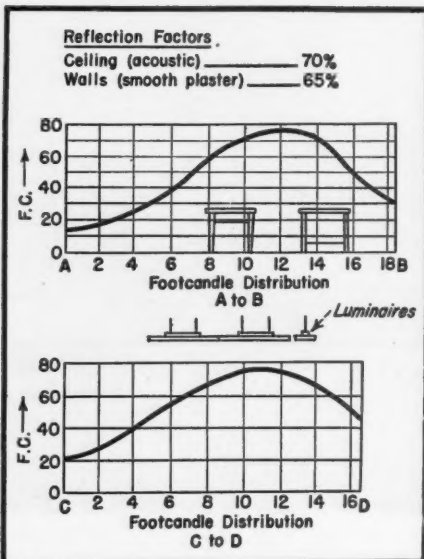


FIG. 6—Footcandle intensities indicated were measured after 1000 hours burning. Four luminaires, each of type shown in Fig. 7 and using four 40 watt white lamps were used, suspended 28 inches overall from ceiling.

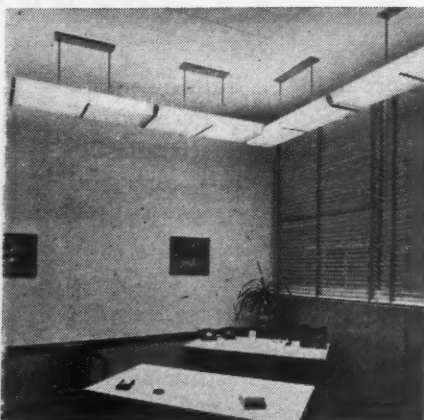


FIG. 7 — Note uniform intensity throughout this office. Desk and table are equipped with light colored tops to prevent high contrast.

accomplish similar results. Shown in Fig. 5 is an L-shape layout, whose foot-candle distribution curves (Fig. 6) are based on the use of direct-indirect type luminaires, shown in photo, Fig. 7. This office is 13 feet 6 inches by 16 feet 6 inches, with 70 percent reflection factor acoustical ceiling and 65 percent reflection factor smooth plaster walls. Lamps had been burning 1000 hours when light intensities were measured.

Another example of layout design is given in Fig. 8. This office is 16 feet 6 inches by 18 feet 3 inches. Recessed troffers using two 40 watt lamps in each four foot length are installed in a rectangular pattern, and ten 4-foot length units are used. Light intensities and distribution are shown in curve Fig. 9, as well as in footcandles measured (Fig. 8) after 400 hours of operation. This fin-

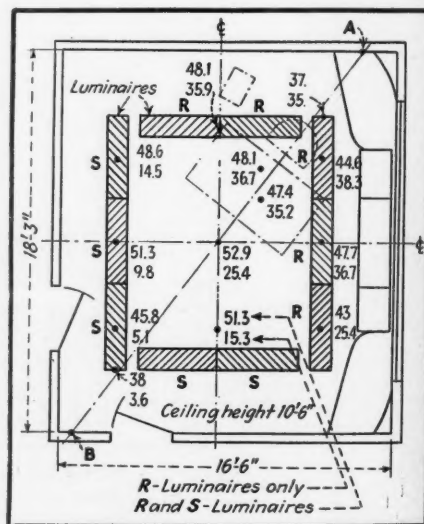


FIG. 8—By forming a rectangle or square design with 2-lamp, 40-watt, troffer units, flexibility in lighting can be had by separately switching the "R" and "S" units. With both "on" for conferences, an average of 43 footcandles from A to B was obtained. To eliminate annoying reflected glare for the person working at the desk, luminaires "S" should be "turned off" thus having only the "R" luminaires lighted. The illumination on the desk reduces slightly, while the average reduces considerably.

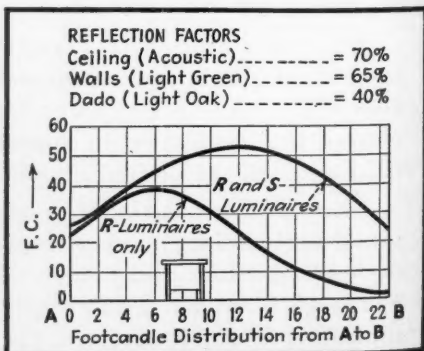
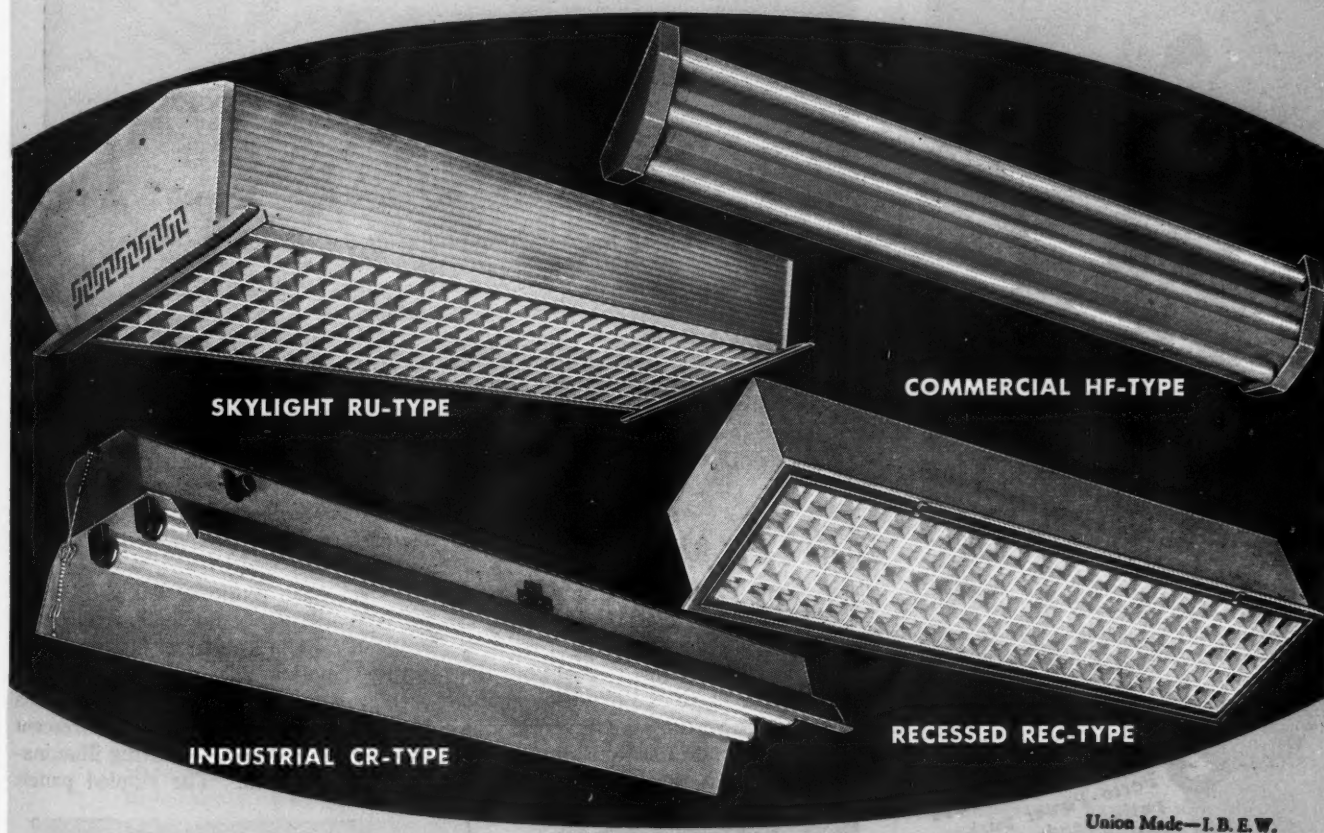


FIG. 9—Data refers to Fig. 8, and shows footcandle intensities diagonally across the room normal to desk. Readings were made after 400 hours burning with 3500° white lamps.

A NEW COMPLETE LINE of *All-bright* **FLUORESCENT FIXTURES**

built to meet every lighting need



The ALL-BRIGHT fluorescent fixtures are custom-built—and are designed and engineered for every lighting purpose in store, office, factory and drafting room. They provide greater foot-candle intensity, keener visibility and add a definite "eye-appeal." They offer full-time, trouble-free service. Available with "Instant-Start" ballast. No starters required . . . lights with the flick of a switch. Suspension or flush mounting—individual or continuous rows . . . *there is an All-Bright unit to fit your needs!*

FOR A BRIGHTER WORLD

*Send for new descriptive catalog
showing many more styles available.*



ALL-BRIGHT ELECTRIC PRODUCTS COMPANY

Manufacturers of Fluorescent Lighting Fixtures

3917 N. Kedzie Ave.

Chicago 16, Illinois

You get
ALL THREE with a
BLACKHAWK
PIPE BENDER



Blackhawk Benders do MORE than bend pipe. They include a Porto-Power Hydraulic Unit that performs this triple job:

1 PIPE BENDING
Bends rigid conduit and pipe of all popular diameters. Saves need for elbows, couplings and extra cutting and threading.

2 MAINTENANCE and PRODUCTION
Porto-Power pushes, pulls, bends, presses, spreads, and clamps—pulls gears, lifts machinery and licks scores of other jobs.

3 SPECIAL JACK
Compact Hydraulic Ram works in all directions—at any angle. A versatile, safe, remotely controlled jack.

Blackhawk Mfg. Company,
Dept. P2066, Milwaukee 1, Wis.
Mail Hydraulic Equipment catalog to:

Name _____

Company _____

Address _____

BLACKHAWK
WORLD'S LARGEST MANUFACTURER OF HYDRAULIC JACKS

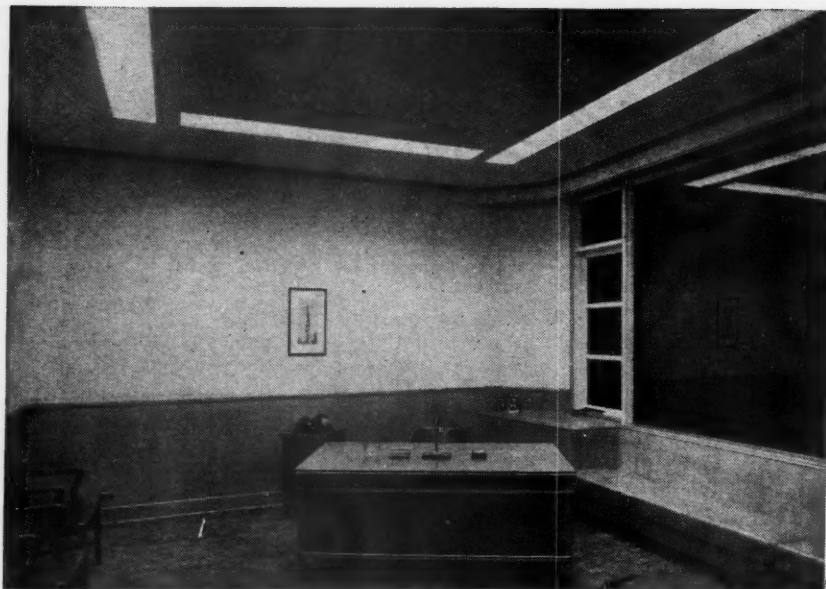


FIG. 14—With "R" and "S" luminaires of the office in Fig. 8 lighted, the reflected glare of the "S" luminaires is clearly shown. With only the "R" luminaires lighted, the objectionable reflected glare is eliminated for the person working at the desk.

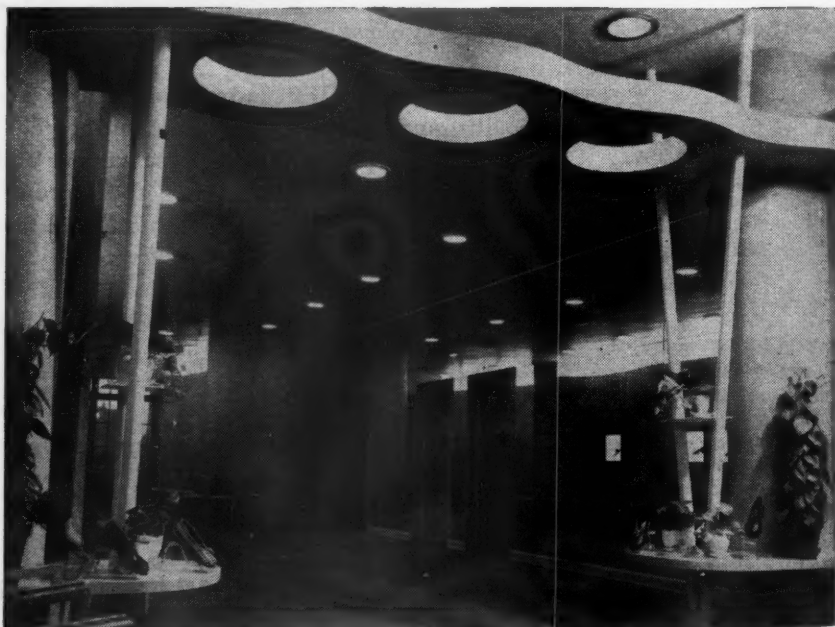
ished installation is shown in the photo (Fig. 10). Reflection factor of the acoustic ceiling is 70 percent, and of the pale green walls is 65 percent. The light oak dado has a reflection factor of 40 percent.

VARIED SOURCES CREATE INTEREST

Selling modern footwear in a modern setting is the attained goal of the Geuting Shoe Store of Philadelphia, Pa. The picture, showing the foyer of one of six floors, indicates four treatments used to combine the recessed or cove

lighting with the architectural design.

Circular louvres used in connection with recessed 100-watt lamps create a sharp cutoff cone of illumination while directing light through large round openings in the decorative arch to merchandise counters. General light from series of similarly recessed lamps is diffused through etched glass lensed discs set flush with the flat white ceiling. Wall treatments combine the generous use of large mirrored areas with gently rippling pale green side panels acting as light baffles for the continuous single rows of 40-watt white fluorescent lamps supplying cove-radiating illumination to the room. The rippled panels



Combinations of recessed and cove lighting are employed with large mirrored areas and modernistic architectural treatments to achieve a novel, interesting and restful atmosphere.

It will pay you to know the answers to these questions about



What "Certified" means on a ballast

Q. What's behind the idea of the Certified Ballast Manufacturers?

A. The best engineering brains in fluorescent lighting drew up a set of exacting specifications for ballast manufacture—plus testing procedure—to insure satisfactory lamp performance, dependable fixture operation, minimum service worries.

Q. What does "Certified" actually stand for?

A. Ballast manufacturers build their products to the specifications . . . submit random factory samples to impartial Electrical Testing Laboratories, Inc., of New York. The laboratory tests and checks the ballasts to the specifications. If the ballasts meet all tests, E.T.L. CERTIFIES them—permits the manufacturer to use the ETL Certification label on his product.

Q. How about this "testing"?

A. Independent testing by ETL is a searching, ex-

acting procedure. It covers such vital points as heating, noise, radio interference, lamp operation, wiring, power factor and many others. And ETL inspectors *recheck* samples weekly at the various factories . . . to guard quality.

Q. What are the benefits to the trade?

A. It is assurance that tubes and fixtures will perform and operate to their fullest capacities. It is important to note that leading fluorescent tube makers will guarantee lamp performance when Certified Ballasts are specified in fixtures.

Q. What are the benefits to the user?

A. Certified Ballasts help assure the user of good lamp performance, good fixture operation, and a minimum of maintenance worries. Light-for-selling depends on reliable day-in-day-out service. That's why the use of Certified Ballasts is a sound, easy way to protect yourselves and your customers.

Certified Ballast Manufacturers

Makers of Certified Ballasts for Fluorescent Lighting Fixtures

CHICAGO TRANSFORMER CORP.
3501 Addison St., Chicago, Illinois

GENERAL ELECTRIC CO.
Specialty Transformer Division
1635 Broadway, Fort Wayne, Ind.

JEFFERSON ELECTRIC CO.
Bellwood, Illinois

SOLA ELECTRIC CO.
2525 Clybourn Ave., Chicago 14, Illinois

WHEELER INSULATED WIRE CO.
378 Washington Ave., Bridgeport, Conn.



—MCGILL—

Safety Vaporproof GUARDS...with Tight-sealing Globes



Approved by
Underwriters



Safeguard Life and Property

Where there is a possibility of fire, or other disaster from a spark, exposed flame, heat or breaking of bulbs, then McGill Vaporproof Lamp Guards should be used on all portable or extension lights. The tight-sealing globe and heavy cage, with air-tight seal in handle opening, eliminate these hazards at every spot where this guard is used. These Vaporproof guards are designed to stand up under roughest use and abuse.

These guards also protect the light bulb and prevent breakage when used around machines where water and oil might splash on the bulb. Guards also are grounded — an additional safety feature.

—MCGILL—

MANUFACTURING CO., INC.
Electrical Division
VALPARAISO, INDIANA

contain recessed display cases which are top lighted by twin 20-watt white fluorescent tubes. The flat white interior treatment of these panels is emphasized by dark green frames. The reflection of the cove lighting and recessed display cases may be seen in the mirrored walls surrounding the starred elevator doors in the center rear of the photograph. Buff broadloom carpeting completes the atmosphere of restfulness.

OBLIQUE FIXTURE MOUNTING MINIMIZES INSTRUMENT SHADOW

Uniformity of high level illumination is maintained in the drafting rooms of the Willamette Iron and Steel Shipbuilding Company of Portland, Oregon, by an installation of totally direct continuous fluorescent lines of light. Following the theory of 45 degree mounting to eliminate shadows along T-square and triangle edges, series of Guth utility Fluoflectors with Alzak aluminum reflectors and eggcrate louvres are installed obliquely between ceiling beams. The fixtures, each containing two 40-watt 3500 degree white fluorescent lamps, are surface mounted on a 6-foot row-to-row plan against the 10-foot ceiling, tiled with light cream colored acoustical panels. Beams, columns and walls are similarly tiled, giving the room a neat, uniform, restful appearance. The relatively close spacing of fixtures creates an even dis-

tribution of low brightness illumination which, after three months of operation, is reported to be 74 footcandles at working level over the entire area. The light load is 3.8 watts per square foot.

Low brightness and angular mounting tends to minimize glare and eliminate specular reflection from tracing cloth and instruments although sufficient light is reflected from drafting boards to eliminate distracting dark areas from the ceiling between fixture runs. Venetian blinds shield the boards from the direct rays of exterior light and act as baffles to direct secondary illumination to the acoustical ceiling.

The installation was engineered by L. M. Baxter of Portland.

LIGHT AND COLOR TRIPLES CLASSROOM ILLUMINATION

Harmoniously blending color with light in schoolrooms is receiving the attention and approval of PTA members, faculty staffs and students in northern New Jersey. Typical classrooms in the high schools of Hackettstown and Washington, Warren County, have been experimentally illuminated with fluorescent light and painted with scientifically blended color. Since both schools are used for state teachers' extension courses, PTA gatherings and other civic meetings as well as for the daily instruction of students, the lighting campaigns which the installations have silently and visually promoted are prov-



Continuous runs of surface mounted direct fluorescent fixtures maintain high footcandle uniformity over the entire drafting area. Closely spaced, angularly mounted lines of light create low brightness, shadowless illumination.

For accurate machine work...

assembly or inspection



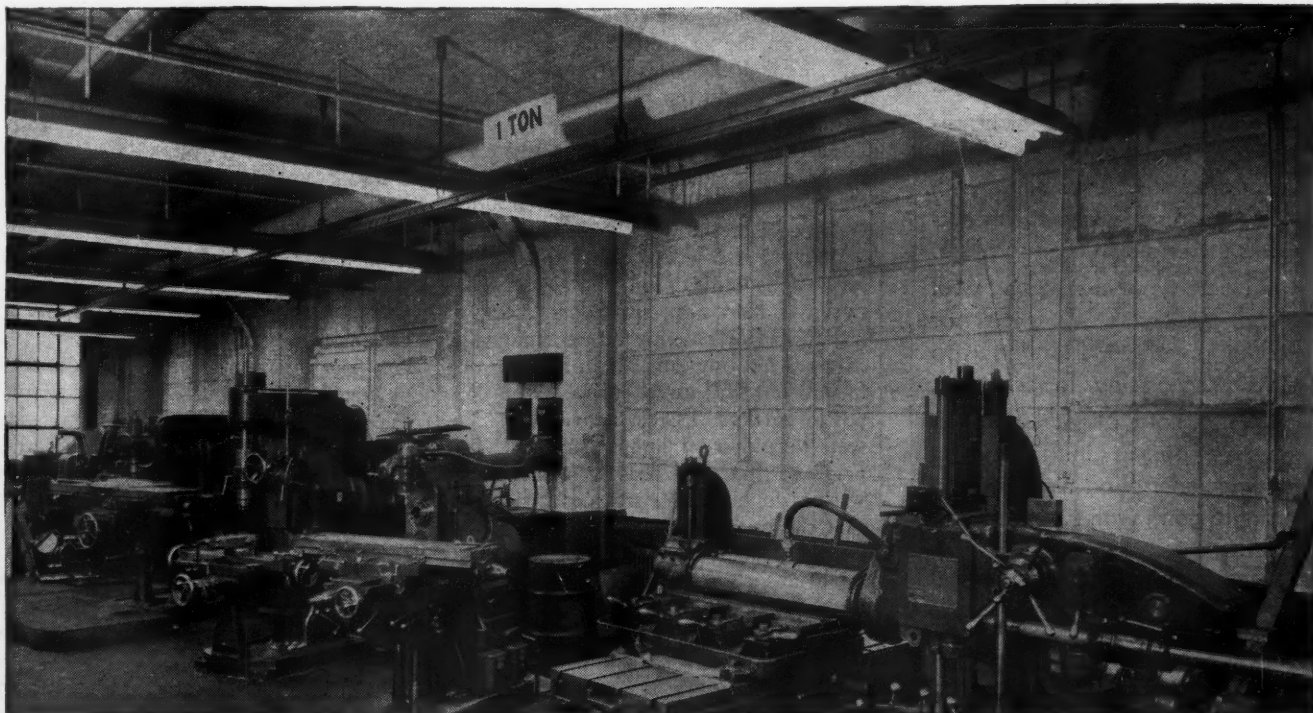
The Westinghouse Type FNC Continuous Strip Luminaire—for two or three 40-watt lamps or two 100-watt fluorescent lamps. Porcelain enamel steel reflector, R.L.M. approved.

Where light intensities of 35 to 100 footcandles are essential for close precision work, continuous strip fluorescent equipment has proved to be most efficient.

It provides high illumination levels for difficult seeing tasks, without annoying glare or shadows. Installation is simplified, with hanger mounting accessories to meet every application need.

For maximum industrial lighting efficiency, install Westinghouse lighting equipment. There's a type specially designed for every application need—and a Westinghouse Lighting Specialist ready to work with you. Ask your nearest Westinghouse Lighting Distributor for B-3604—"A Guide to Better Industrial See-ability". Or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-04097-B



Westinghouse

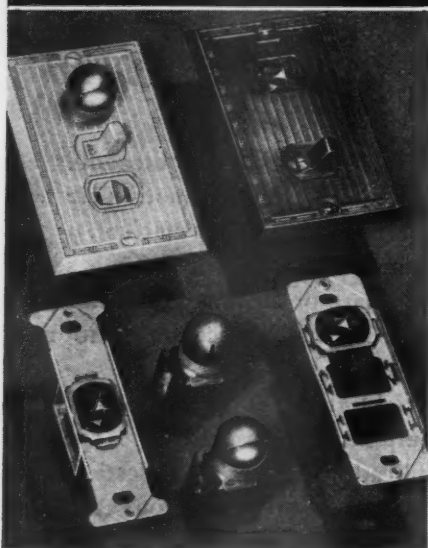
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE



AVAILABLE THROUGH 127 WESTINGHOUSE ELECTRIC SUPPLY OFFICES AND INDEPENDENT JOBBERS

Electrical Contracting, June 1946

P&S PILOTS



THE WAY TO



SAFETY ECONOMY

Versatile — compact — suitable for a variety of installations — P&S Pilot Lights illustrated may be combined with P&S-Despard switches or outlets under a single gang plate.

Flush type available with red, green, blue, amber or opal jewels — Hooded type with red or clear lamps.

Also note Night Light unit which permits installation of switch-controlled night light in single gang with switch or outlet.

Consult your P&S Catalog if you have a pilot light problem.

Sold Thru
**ELECTRICAL
WHOLESALE**

PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK



A rural classroom assumes its rightful recognition as a modern center of learning when a thousand watts of fluorescent lighting is blended with scientifically recommended paint treatments. Continuous fixtures are mounted nearer interior wall to utilize booster light from natural exterior brightness.

ing far reaching over the 1200 square miles of Warren, Hunterdon and Morris Counties.

Since both classrooms received comparable treatment, a tabulation of the data obtained from one gives a fair picture of the results. The specific details, here discussed, apply to the study room located in the Hackettstown High School.

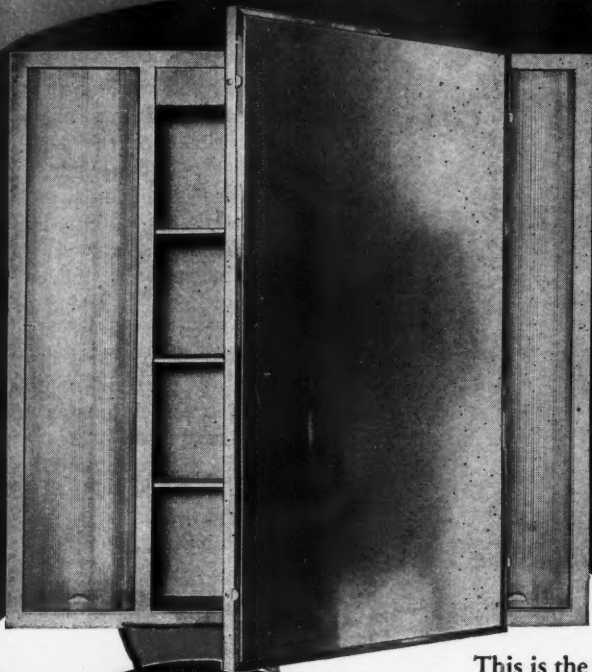
The room measures 23 feet 10 inches by 32 feet 6 inches and has a ceiling height of 12 ft. Windows stretch along 80 percent of the western wall from the dado level at 3 feet 5 inches to the ceiling. This indicates a liberal ratio between window area and floor surface of 230 to 775 or roughly 30 percent. The original lighting consisted of two translucent bowl fixtures suspended in opposite corners, 18 feet apart, with 200-watt incandescent lamps enclosed. Just prior to the war heavier conduit and wiring doubled the carrying capacity so that the number of fixtures in the room could be increased from two to four. Light-absorbing blackboards covered both the front and eastern side wall. Color selection combined a flat white ceiling with a medium tan treatment of walls and a dark brown covering for wainscoting, rear wardrobes and trim around the door and windows. Natural light from the windows on a bright afternoon provided 30 footcandles of illumination on the desk surfaces nearest the windows and three footcandles to the desks nearest the eastern blackboards. Using the four 200 watt incandescent lamps in conjunction with the natural light raised these figures to 35 and 10. The readings in the darker part

of the room serve as indications of the overall light level during evening sessions when natural illumination was absent.

The present lighting plan utilizes two rows of continuous fluorescents, each row containing five Day-Brite Viz-Aid fixtures mounting two 40-watt white tubular lamps. Units have a lateral louvered bottom, sides of ribbed diffusing glass and longitudinal top openings either side of the chassis. Direct illumination, passing downward to the desks, is strengthened by the reflected rays from the ceiling. Additional fixtures, transversely located over the front chalkboards, would be beneficial but as yet have not been installed.

Since the rooms are principally used during daylight hours, the benefits from the outside natural illumination was considered in locating the fixtures. Rather than symmetrically space the two rows equidistantly from the center line of the room, the fixtures were moved laterally towards the interior wall so that the rows are now approximately 10 feet from the windows, 6 feet from the eastern wall, 8 feet apart and 19 inches from the ceiling.

In repainting the room, color harmony was seriously considered for reducing eye fatigue of those employed in prolonged and concentrated study. This harmony was obtained by complementing the prevalent colors in both the natural and artificial light. Cool green was selected to complement the prevailing warm reddish tint of the western sky and eliminate possible color monotony. Changing the color of the front blackboard was considered but it was found



FREDDY FIREFLY

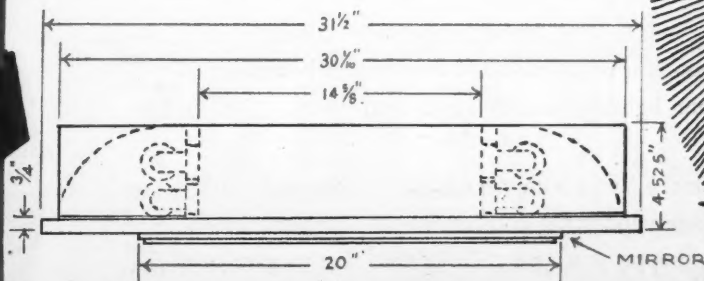
presents tomorrow's

FLUORESCENT BATHROOM CABINET



Uses 4 concealed 20 watt
fluorescent lights... 2 on
each side of 20 inch mirror.

Sectional View



This is the **FIRST** bathroom cabinet in which fluorescent lighting has been actually constructed into the cabinet itself.

The fluorescent lamps are **COMPLETELY CONCEALED** behind the cabinet door.

The concave built-in reflectors on each side of the cabinet project the light onto **YOUR** face as you stand before the mirror. Your face is (by indirect light) evenly and softly illuminated by the light from these concave surfaces. To further soften the light, the light source openings are covered with Skytex refracting glass panels that slide into convenient grooves. Your face is then seen in the mirror without objectionable glare... it is by far the most modern and practical method of illumination yet conceived.

Sold as a complete unit, ready for immediate installation in new or present homes. Constructed to be recessed into the wall between two studs.

For details on this new "Freddy Firefly **FIRST**" write direct for name of your nearest jobber or contractor.



KAHN MFG. CO. INC.

2051 NORTH 19TH STREET MILWAUKEE 5, WIS.

Formerly Fluorescent Fixtures, Inc.



Fluorescent and Incandescent Lamps for industry bearing the Champion *diamond* mark are shining examples of:

- 1 **Quality** — the result of forty-six years of concentration on fine lamps for industrial service. Guaranteed to equal or exceed Federal Specifications and backed by the resources of one of the largest lamp producers in the industry.
- 2 **Lighting Service** — trained lighting experts at all times available in the field to give you competent and unbiased recommendations on correct lighting applications for every shop and office purpose.
- 3 **Economy** — Champion production and distribution is organized to insure minimum lighting cost and lower lamp costs.



Look for the lamps with the Champion diamond mark. A competent industrial distributor near your plant stands ready to supply you with CHAMPIONS. Let us give you his name.

CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.



that the deep grey of the slate most ideally complemented the white fluorescence of the artificial light source. Velvet toned Arco Optonic greyed green covers the upper walls, unused side blackboard and window trim. The dado and rear wardrobes are a semi gloss darker shade of the same basic color. All colors produced in the laboratories of the Arco Company have the two-fold objective of eliminating color monotony and reducing excessive brightness contrast between the students' work and the background. Blended scientifically with either white or black, the pure colors may be obtained in an infinite number of greyed combinations. Using greyed tones eliminates undesirable color intensity and makes it possible to control the reflection factor of walls as well as the brightness contrast between desk work and background.

Meter readings under natural lighting conditions now register 35 footcandles near the windows and $4\frac{1}{2}$ footcandles by the interior walls. With fixtures lighted the intensities are now 55 and 35 footcandles. During evening sessions the average intensity is 30 footcandles. These readings were taken two months after the installation had been completed.

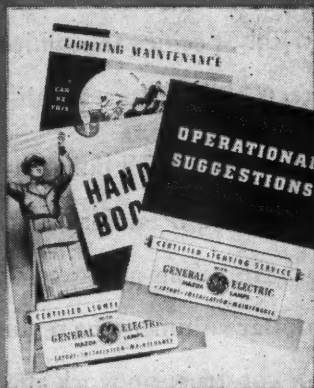
The overall lighting and color plan was designed and supervised by R. G. Cass, lighting engineer of the New Jersey Power and Light Company. The Day Brite fixtures were installed by the Hackettstown Electric Company. The similar classroom located in the Washington High School is lighted with Westinghouse continuous fluorescent suspended louvred fixtures, installed by F. L. Suttle of Washington. Arco paint was used in both classrooms.



Denny Freeman, PBA electrical engineer, Office of Buildings Management, Washington, D. C., outlined four typical lighting problems and their solutions as worked out by PBA engineers, in a discussion before the IES East Central Regional Conference, Philadelphia, Pa.

ACTION NOW

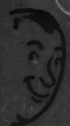
... to help you build a profitable commercial business



Illustrated above are typical war-proved devices featured in the new G-E Program. Brilliant movies, sound-slide films, charts and useful sales aids are all combined in this brand-new, up-to-date program.



GET ALL THE FACTS
about the G-E Coordinated Sales Lighting Program for Contractors. Don't delay. Call your nearby G-E Lamp Representative for booklet that gives full details.



Here's a brand-new G-E Program to help Contractors sign up Store Lighting Jobs

It gives you everything you need to coordinate your man power with equipment sales and installation



Four fact-packed meetings show the value of and how to capitalize on modern sales lighting



WITH the new and easy-to-understand G-E Coordinated Sales Lighting Program to provide the facts, figures, and ideas—even apprentices can start more store lighting sales.

Now ready, the program plans for a series of four meetings that give you ready-to-use tools and techniques to: (1) locate and develop prospects and meet their individual needs with modern equipment properly installed, and (2) get better profits from both installation and equipment, increasing your share of today's huge commercial sales lighting market.

It's the most useful practical program ever offered. It's ready to help you cash in—TODAY.

G-E LAMPS

Constantly improved by research to

Stay Brighter Longer!



GENERAL ELECTRIC

**COMING
IN SEPTEMBER**

..... MASTER A REFERENCE BOOK AND WIRING LAYOUTS FOR A

WITH the increasing dependence upon electricity in manufacturing plants, in hospitals, hotels, stores and offices, in homes and on farms, the electrical installation becomes a larger and more essential part of every construction job.

Because of his intimate knowledge of electrical systems and of electrical materials, the electrical contractor, either alone or working with the owner's representative, is being called on more and more to help design and write specifications for these important electrical installations.

Detailed specifications must always be prepared by the electrical contractor from the general plans submitted by the owner or by the architect.

Adequate electrical systems using high quality materials can be the rule, not the exception, only when good, tight specifications are drawn.

That is why in 1936 and 1939, Electrical Contracting initiated the movement to abolish loosely drawn specifications by publishing a Master Electrical Specification which was acclaimed by architects and contractors alike.

Now, with building once more on the march, there is a need for a similar job promoting better specifications and greater adequacy of wiring. The dollar volume to be realized from the large amount of construction work ahead will depend heavily on the standards established for adequate electrical installations and for the quality of electrical materials to be used.

These standards will be high or low depending upon the specifications drawn for each electrical installation. Right now is the time to set up quality specifications for all electrical construction.

ALSO IN THE SEPTEMBER ISSUE—REVIEW OF THE NATIONAL ELECTRICAL CODE, 1946 REVISION — ALL CHANGES IN THE CODE WILL BE POINTED OUT, DISCUSSED AND INTERPRETED IN A TEN PAGE SUMMARY

BOOK OF ELECTRICAL SPECIFICATIONS

OF SPECIFICATION PARAGRAPHS

FOR ALL TYPES OF OCCUPANCIES

Electrical Contracting will publish a 60-page feature section on **ELECTRICAL SPECIFICATIONS** — how to plan and write them for every type of electrical wiring layout. It will be simply written and helpfully illustrated, so that the material will be easy to understand and to use.

Specification paragraph numbers will follow the standard numerical code used by the American Institute of Architects.

You will want to use this issue as a reference when planning all your future installations.

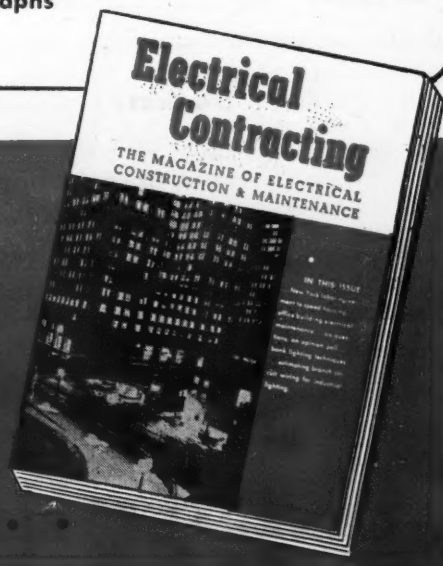
Additional copies may be had at \$1.00 per copy by writing directly to Electrical Contracting.

MASTER ELECTRICAL SPECIFICATIONS, SEPTEMBER 1946

1. Design Procedure
2. Wiring Check Charts
3. Standards for Wiring for Lighting in Commercial, Public and Industrial Occupancies
4. Standards for Power Wiring
5. Standards for Wiring in Single-Family Dwellings
6. Standards for Wiring for Lighting in Multi-Family Dwellings
7. Specifications for Wiring in Commercial, Public and Industrial Occupancies
8. Specifications for Auxiliary Electrical Systems
9. Specifications for Wiring in Single-Family Dwellings
10. Engineering Data — Diagrams — Photographs

SPECIAL PRODUCT INDEX

To help you find sources of supply when you are drawing up detailed specifications and referring to this Master Electrical Specification, Electrical Contracting will include a **Manufacturers' Product Index** in this September issue. All products advertised will be listed under name of supplier and under general product headings.





Contractor: I hear you're having a hard time with your new housing development. I suppose wiring is going to take a beating.

Builder: No — I don't think so. Cutting the wiring to the absolute minimum won't save enough to make it worth while. I have a reputation for building up-to-date homes, you know, not houses that are obsolete before the paint is dry. I want to protect that reputation.

Contractor: You mean to say that you will insist on a real adequate wiring job even in your low-cost houses?

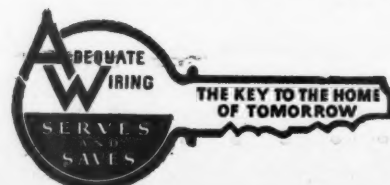
Builder: I sure will. In my low-cost houses I'll have to omit some of the extras that people want. But small home owners use just as much electricity as people who live in large homes — even more maybe. And I sure won't leave out anything as essential as a sound wiring system.

Contractor: I'm real glad you feel that way. And I'm sure that good wiring will not only help to sell your houses, but will keep the owners satisfied as long as they live in them. That's a selling idea I'm going to start pushing right now.

GENERAL  ELECTRIC

P.S.

Why not ask your G-E representative how you can benefit from the promotion of adequate wiring in residential, industrial, and other buildings. Or you may want to write for information to Section AW661-8, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.



ELECTRONICS

Basic Circuits for an Electronic Adjustable Speed Drive

By Harold J. Hague
Electronic Application Engineer
Westinghouse Electric Corporation
East Pittsburgh, Pa.

A simplified schematic circuit diagram of an elementary electronic rectifier motor system as shown in Figure 1, illustrates how two Thyatron tubes are connected for a conventional single phase full wave rectifier. The output voltage of the rectifier is unidirectional. The motor armature is shown connected between the cathodes of the tube and the center tap of the rectifier (anode) transformer. The alternating current component of the grid voltage applied to the grids of the tubes from the control-grid transformer is shifted so it lags in phase the anode voltage by 90 degrees. A dephasing circuit consisting of a resistance R5 and a capacitance C5 supplies the voltage to the primary winding of the control grid transformer.

The grid voltage applied to the Thyatron tubes includes a direct current

component which is a combination of two voltages across portions of P1 and P5. The direct current voltage can be varied from a negative value to a positive value by changing the setting of one potentiometer P1 and in this way control the firing angle of the rectifier tubes.

While batteries are shown to represent auxiliary sources of direct current voltage, none are actually used in the electronic adjustable speed drive as the d-c potentials are supplied by rectifiers.

Even though the speed of the motor can be varied by the adjustment of the speed control potentiometer P1 or P5, the speed of the motor also depends upon the mechanical torque on the shaft. This is due to: (1) the armature voltage drop (IR), and (2) the decrease in the armature voltage with increasing torque. The latter is of prime importance due to its predominating effect on the behavior of the rectifier drive.

Circuit for Improved Speed Regulation

The speed regulation can be substantially improved if the firing angle of the rectifier tube is automatically adjusted in accordance with variations in torque. That is, advance the firing of the tube with increasing torque and conversely, retard the firing with decreasing torque so as to maintain constant speed for any particular setting of the speed control potentiometer P1 or P5.

However, in order to provide means for automatically adjusting the firing angle so as to make the speed of the motor independent of torque, a speed

indicating system is necessary. The indicating system must provide a physical value. For example, a voltage that is directly proportional to the speed of the motor. Also, the system must be capable of influencing the control circuits in such a manner that these can supply the proper correction to restore the motor to its previous speed. The well-known tachometer generator is one of the best indicating systems, since it is usually mounted on the shaft of the motor and, therefore, generates a voltage that is directly proportional to the motor speed. However, the tachometer generator indicating system offers a number of disadvantages for the average installation. It requires additional equipment, more space, is somewhat more expensive, and offers increased maintenance problems. Though the tachometer generator system offers the above-mentioned disadvantages, it permits much closer regulation than can be obtained with other systems and furthermore, can be used to synchronize several drives which otherwise could not be synchronized. Inasmuch as the majority of applications do not require the extremely close regulation that is usually associated with drives incorporating the tachometer, a circuit that will indicate the feedback from the armature voltage will constitute a definite advantage. Figure 2 is a schematic diagram of a rectifier drive for a direct current motor with a feedback circuit that will improve speed regulation due to the fact that at varying loads the voltage across the armature is maintained constant at a value corresponding to a particular setting of the speed-control potentiometer.

The fundamental rectifier circuit is identical with that shown in Figure 1; however, the variable direct current component is developed in the Thyra-

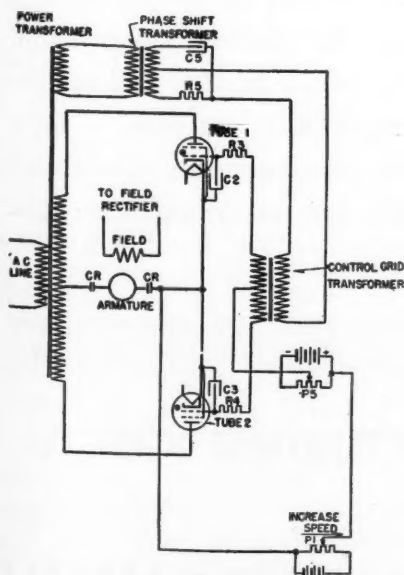


Fig. 1—Elementary rectifier drive without speed-regulating circuit.

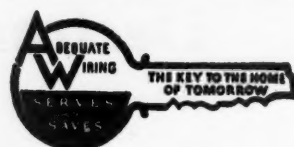
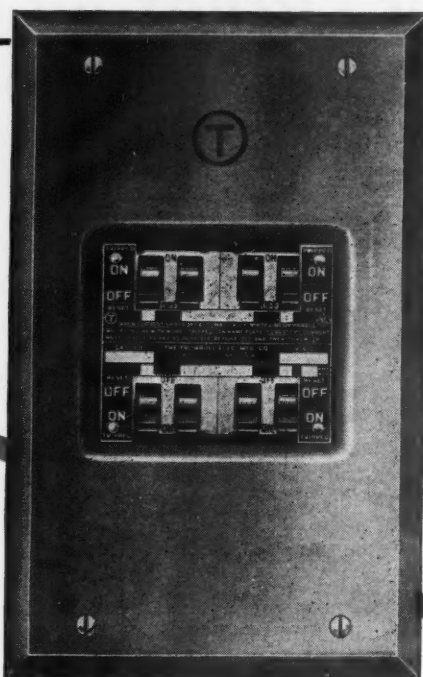
TRUMBULL

MULTI-BREAKER LOAD CENTERS

Fuseless

It isn't really
ADEQUATE WIRING
without modern
MULTI-BREAKER
PROTECTION

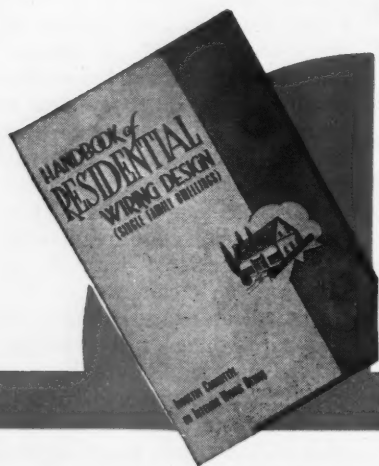
This new "Handbook of Residential Wiring" is available from Electrical Contractors, Wholesalers, or through your local Lighting Company. See particularly pages 16, 17 and 18.



Why? Because the Adequate Wiring Program covers a lot more ground than just an ample capacity in the main service cables, plenty of circuits, wall switches and outlets.

Trumbull Multi-Breakers . . . proven by more than a million circuits already in use for residential protection . . . further all these aims . . . but *add one*

big advantage; they save the cost and inconvenience of service calls. There are NO FUSES TO RENEW, nothing to replace when a Multi-Breaker "opens". Any child can "flip" the switch and restore service after the cause of trouble has been removed. And the important point is that this modern FUSELESS protection is not a "rich man's gadget". It is low enough in price to be used in minimum cost housing budgets RIGHT NOW. For full information write Trumbull today.



THE TRUMBULL ELECTRIC MANUFACTURING CO.
PLAINVILLE, CONNECTICUT

OTHER FACTORIES AT

NORWOOD, OHIO — LOS ANGELES — SAN FRANCISCO — SEATTLE

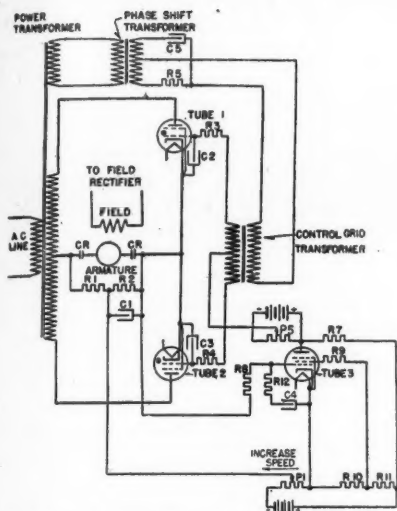


Fig. 2—Schematic diagram of a rectifier drive with armature voltage regulating circuit.

tron grid circuit from the cathode R2 portion through speed-control potentiometer P1, fixed resistors R10, R11, and R7 potentiometer P5 to the center tap of the secondary winding of the grid control transformer. Since the voltage across the armature voltage feedback resistor R2 and P1 are low in comparison with the voltages across the other circuit components, these may be disregarded. The sum of the direct current voltages across R10-R11 and R7 has a constant value; however, the load voltage of the control tube varies in proportion with the plate current. It is this variable voltage that determines the value of the direct current component of the Thyatron grid voltage and hence the output of the rectifier.

The combination of voltages is so arranged that when the plate current of the control tube is equal to zero, the Thyatron tubes will supply the maximum voltage to the armature of the motor. Conversely when the plate current is at a maximum, then the voltage supplied to the motor armature is zero.

The control grid circuit of Tube 3 runs from the cathode through P1, R2, and grid resistor R8. The voltage across P1 is arbitrarily controlled by turning the potentiometer knob. The feedback voltage of the system is obtained from the voltage across R2, and since R2 is connected across the motor armature, the voltage produced is directly proportional to the motor speed. Although the armature voltage contains a pronounced ripple, the effect of the ripple does not disturb the stability of the system by virtue of the fact the circuit of R1-C1-R2 constitutes an effective filter. Thus, the voltage across R2 does not contain any appreciable ripple.

Figure 2 illustrates how the armature

voltage regulating circuit has been added to a rectifier-motor drive. However, the voltage across the armature is not a very accurate indication of speed since the armature voltage drop may result in as much as ten percent regulation at high speeds and at low speeds has a still greater effect on variations of speed with load as shown by the following formula:

Equation for determining the speed of a motor:

$$N = K \left(\frac{E_a - IR}{\phi} \right)$$

N = Speed of Motor

K = Constant of Proportionality

E_a = Voltage Applied Across Terminal of Armature

I = Armature Current

R = Armature Resistance

φ = Flux

The numerator of the equation is also called the E.M.F. of the motor.

Assuming a condition of constancy for φ and K, these can therefore be omitted from the equation. Under this condition it will be noted that at high speeds E_a can be nearly equal to the line voltage and under this condition that the product of I × R is normally a small portion of E_a. However, at low speeds the product of I × R can be very close to the value of E_a. Thus, IR drop has a very pronounced effect on the motor E.M.F., and hence on the speed of the motor. At high speeds the IR drop within the motor may result in as much as ten percent regulation, and at low speeds the IR drop has a still greater effect on the speed regulation of the electronic adjustable speed drive.

To eliminate the influence of the armature voltage drop on the speed-torque characteristics of the drive, an IR compensating circuit is added as shown in Figure 3. The feedback for the compensating circuit is taken from the armature current and the firing angle of the rectifier tube is additionally adjusted according to load variations

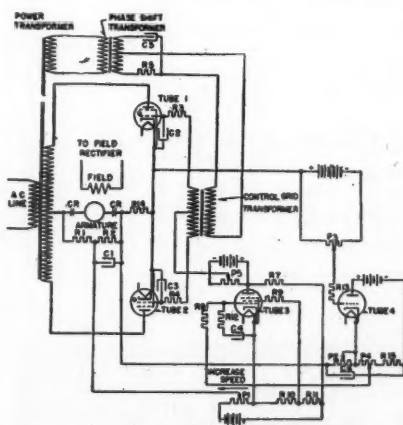


Fig. 3—Further development of the circuit of Figure 2 achieved by adding an IR drop compensating circuit.

in such a way that the armature voltage increases with load and thus providing proper compensation for the armature voltage drop.

Figure 3 has been derived from the voltage regulating circuit by adding a high vacuum triode amplifier, Tube 4 and its allied circuits. Resistor R14 has been added and put in series with the armature winding of the motor. The resistance amounts to only a fraction of an ohm and serves the purpose of indicating the load or torque conditions of the motor.

The grid circuit of Tube 4 consists of the resistor R14, the anti-hunt-control potentiometer P2, grid resistor R13, and the bias-control potentiometer P3.

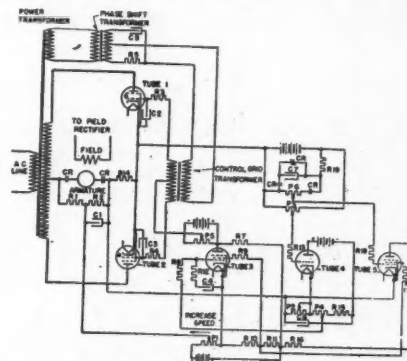


Fig. 4—Schematic diagram of the current limiting circuit added to the basic circuit.

Compensation-control potentiometer P4 and resistor R15 constitute the load resistance of Tube 4.

The grid circuit of the master control Tube 3 now consists of three voltage components, namely: (1) the negative component obtained from the speed-control potentiometer P1, (2) the positive component across the armature voltage feedback resistor R2, and (3) the negative component across a portion of potentiometer P4, the compensation-control potentiometer.

A change in the load on the motor will result in a change in the voltage drop across resistor R14, thus changing the bias of the grid of Tube 4. Consequently, the plate current of this tube will change and thus change the voltage drop across P4. A change in the voltage drop across resistor R4 in turn results in a change in the grid bias of master Tube 3 and thus effectively controls the motor by advancing or retarding the firing angle of the rectifier tubes.

Since the compensating action can be controlled by potentiometer P4, the speed torque characteristics of the drive can be controlled so as to adapt the system to any particular motor application. It is possible to obtain either a drooping or a rising characteristic,



FOR OFFICE SIGNALING SYSTEMS **AUTH** *is all you need*

If you want to put in an office signaling system you can be proud of—one that will eliminate a lot of petty annoyances both for yourself and your customer—your best bet is the Auth line.

You'll like the fact that all the dependable devices you need—annunciators, buzzers, push buttons, intercom phones, paging systems, program clocks, etc. — can be found in one Auth binder.

Your customer will like the way Auth equipment serves him—handy, attractive push buttons—beautifully toned audible signals that (if properly selected) are neither too loud nor too soft—telephone systems that save him time in every way—and annunciators that eliminate all possibility of confusion.

AUTH *is 5 ways better*

1. **ELECTRICAL ENDURANCE**—Auth bells, buzzers, annunciators, intercom phones and other signaling devices are as electrically age-proof as it is possible to make them.
2. **MECHANICAL "GUTS"**—There's severe mechanical usage with most signaling devices, and Auth devices are built to take it.
3. **BEAUTY OF TONE AND APPEARANCE**—an important factor in systems that are in constant use.
4. **EASY TO INSTALL**—Convenient mounting screws—covers easy to remove—plenty of room around terminals.
5. **ENGINEERING SERVICE**. Experienced Auth engineers will be glad to suggest equipment and layouts for your signaling systems jobs. Talk it over with our representative nearest you.

AUTH ELECTRICAL SPECIALTY COMPANY, INC.

422 EAST 53rd STREET

NEW YORK 22, N. Y.

Offices in



Principal Cities

SINCE 1892

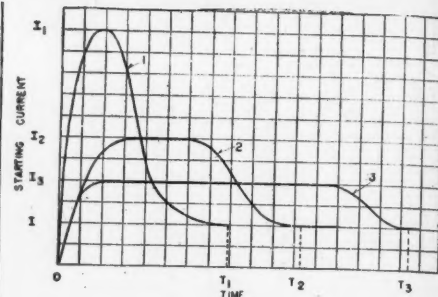


Fig. 5—Curves showing the effect of automatic current limitation during acceleration of the motor. Curve 1 shows current inrush in motor operating from a d-c line. Curves 2 and 3 show the motor current limited automatically by the electronic control to three and two times the full load, respectively.

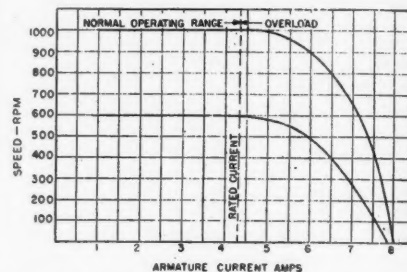


Fig. 6—Curves showing the entire range of speed-torque characteristics. Current is held by the limiting circuit to about twice the rated value.

is zero and it therefore conducts full current resulting in a high voltage drop across the resistor R2. The net result is that the grids of master control Tube 3 are so biased that this tube conducts full current and the rectifier tubes are therefore so biased that they do not conduct. The above action is therefore independent of the setting of the speed-control potentiometer P1.

At the instant the armature contacts marked CR are closed, the voltage across the potentiometer P6 is zero and, therefore, the Thyatron tubes do not conduct. However, the grid bias of Tube 5 is changed gradually by the action of capacitor C7 charging through resistance R19, and as the grid bias gradually changes, the firing angle of the Thyatron rectifier tubes is gradually advanced. Thus, by adding the additional circuit components the magnitude of the first current pulse is restricted to a safe value even before the current limiting feedback circuit has indicated, through resistor R14, that the current in the armature circuit has been exceeded. It should be noted, however, that the time delay provided by the charging of capacitor C7 is of short duration (in order of three or four cycles) and that the remaining acceleration time is controlled by the action of the regular current-limiting circuit through the feedback resistor R14 as previously discussed.



Fig. 7—Control cabinet showing armature rectifier tubes, field rectifier tubes, and control tubes. The dynamic braking resistor is above the tube panel.

and an optimum setting of P4 will result in a practically constant speed for all values of torque and speed within the normal operating range of the drive.

Automatically Controlled Acceleration

In general there are two ways by which the automatic acceleration of a motor can be accomplished: (1) the time delay acceleration, and (2) the current limit method of acceleration. In the first case the voltage applied to the armature is increased gradually to its normal value, so that the motor is allowed to start smoothly. In the second case, provision is made to restrict the armature current to a predetermined value. The current limit method of acceleration has definite advantages in the electronic speed drive in that it permits acceleration that is consistent with the kind of load being driven. Thus, acceleration of the rotating system always takes place under the most advantageous conditions from the standpoint of time and smoothness since the time for acceleration depends upon the mechanical inertia of the rotating system.

To add automatically controlled acceleration to the electronic adjustable speed drive Tube 5 is added to the circuit as shown in Figure 4. This tube is a high vacuum pentode characterized by a sharp cutoff. The power supply for it is common with the master control Tube 3. The grid circuit can be traced from the grid through resistor R18, biasing potentiometer P6, and load current indicating resistor R14.

An analysis of the circuit will show that the armature voltage feedback resistor R2 is in plate circuit of tube.

The function of acceleration control

Everything you need...

FOR ELECTRICAL RESISTANCE MEASUREMENT

From .01 ohm to 200 megohms - IN ONE "MEGGER" UNIT



The "BRIDGE-MEG" Resistance Tester

HERE is a combined "Megger" Insulation Tester and Wheatstone Bridge that has been proved by years of service, and that can be used to measure almost any resistance encountered in electrical equipment—anywhere and at any time. It measures conductor resistance from as low as .01 ohm up to 999,900 ohms, and can be supplied with Varley loop test facilities. It measures insulation resistance from 10,000 ohms up to 200 megohms. Having a self-contained constant pressure generator rated at 250, 500 or 1000 volts d-c, it is independent of batteries or outside source of power supply, and is portable, compact and simple to operate.

To all who have electrical equipment to install or to maintain, and who appreciate the advantages of one superior instrument for all resistance measurements, we recommend and offer the "Bridge-Meg" Resistance Tester. Weight 14 lbs. Dimensions 7" x 8³/₄" x 12".

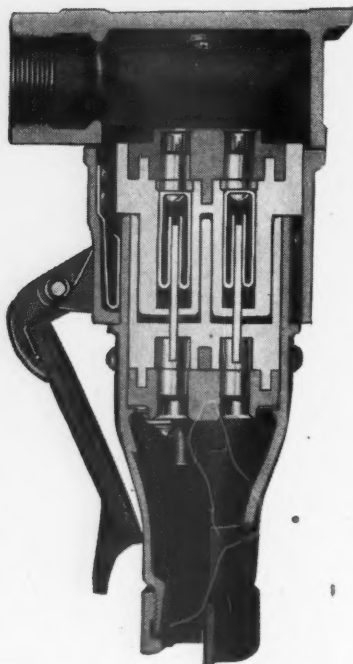
For complete description write for Bulletin 1615-EC.

* Trade Mark Reg. U. S. Pat. Off.

**JAMES G. BIDDLE CO. • 1316 ARCH STREET
PHILADELPHIA 7, PA.**

QUELARC

**The circuit breaking plugs
and receptacles . . .
ratings up to 200 amperes**



The exclusive QuelArc construction provides exceptional protection to contacts, for safe use as current rupturing devices. In the section view, note the complete enclosure of all contacts in insulating chambers which form an arc-trapping space. Note also the long distances from contact to contact and from contacts to ground. Contacts are individually renewable. Full ground protection is provided.

QuelArc plugs and receptacles are available in a complete range of styles, 2, 3, 4-wire types; ratings 20, 30, 60, 100 and 200 amperes. Consult your Pylet catalog for listings of all types.

THE PYLE-NATIONAL COMPANY

1344 N. Kostner Avenue, Chicago 51, Illinois

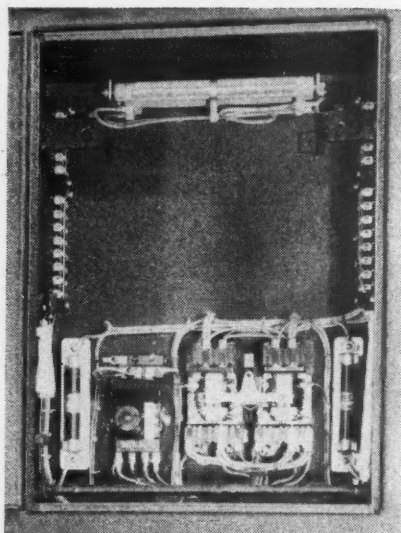


Fig. 8—View of back panel of the Mot-O-Trol showing the dynamic braking resistor, terminal block for connecting the incoming power leads, control station, etc., fuses, motor armature contactors, and time relay used to protect Thyatron tubes against operation before they have reached the operating temperature.

Tube 5 and allied circuits is the opposite of the IR drop compensating circuit (Tube 4). Hence, if Tube 4 tends to advance to firing angle of the rectifier then Tube 5 will tend to retard the firing. However, the amplifying ability of Tube 5 is much greater than the other control tubes, and, therefore, if the armature current increases above a certain value as determined by biasing potentiometer P6, this circuit delays the firing of the Thyatron tubes and thus effectively controls the current in the armature.

When the armature contacts marked CR are closed, the motor will accelerate at a rate that is determined by the setting of the current-limit potentiometer P5 since this controls the current that is permitted to flow through the armature by controlling the grid bias of the Thyatron rectifier tubes.

However, as stated above, the current-limiting control circuit is not in a position to restrict the current until it has exceeded a certain predetermined value. Therefore, control Tube 5 does not affect the angle of ignition at which the first breakdown of the Thyatron rectifier tubes will occur. Thus, the angle of ignition will depend entirely upon the setting of control potentiometer P1, and the first impulse of current flowing through the armature may reach a high value. The limit of current in this case would be determined by the resistance and inductance of the armature winding, and if the speed-control potentiometer P1 were set for high speed the armature rectifier tubes would be damaged due to the peak current demanded by the armature.

To overcome this limitation, an auxiliary circuit can be added that will provide additional time-delaying action during the starting of the motor, so that in effect both features of the time-delay method of acceleration and of the current-limit method of acceleration are incorporated. The added circuit includes a capacitor C7, a resistor R19 and contacts of CR. When the armature contacts marked CR are open, the voltage across the capacitor C7 and the resistor R19 are zero.

To obtain a clearer conception of the operation of the current limiting feature of the electronic adjustable speed drive it is only necessary to refer to Figure 5 which shows the effect of automatic current limitation during the acceleration of the motor.

Curve 1 shows the current inrush in a motor that is operated directly from a direct current power line. Curves 2 and 3 show the current inrush in a motor that has the current automatically limited by the electronic control to three and two times full load current respectively.

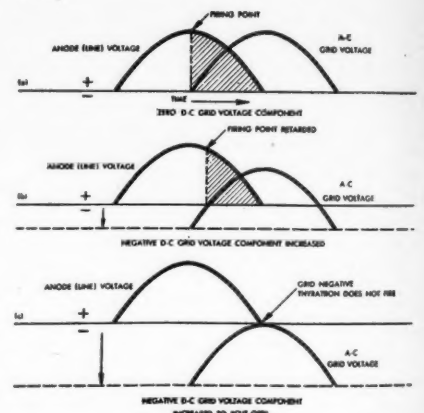
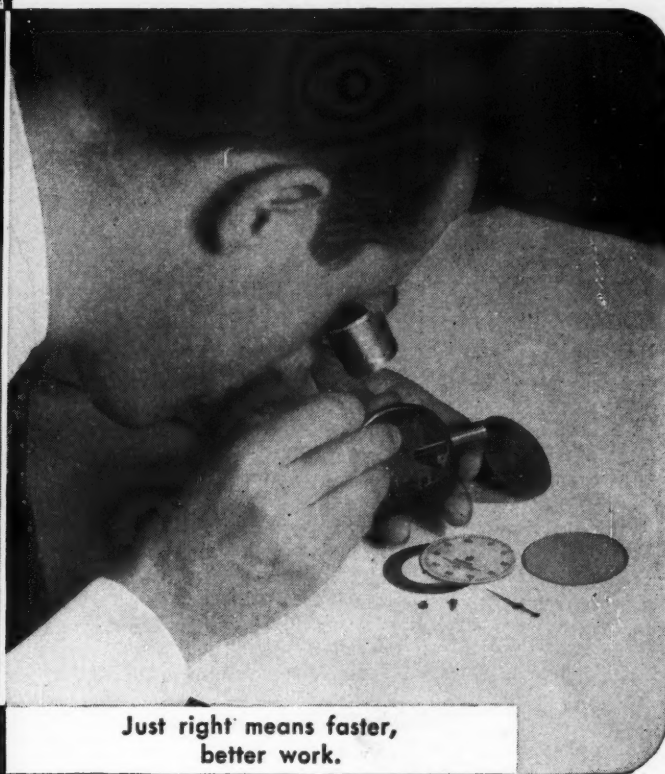
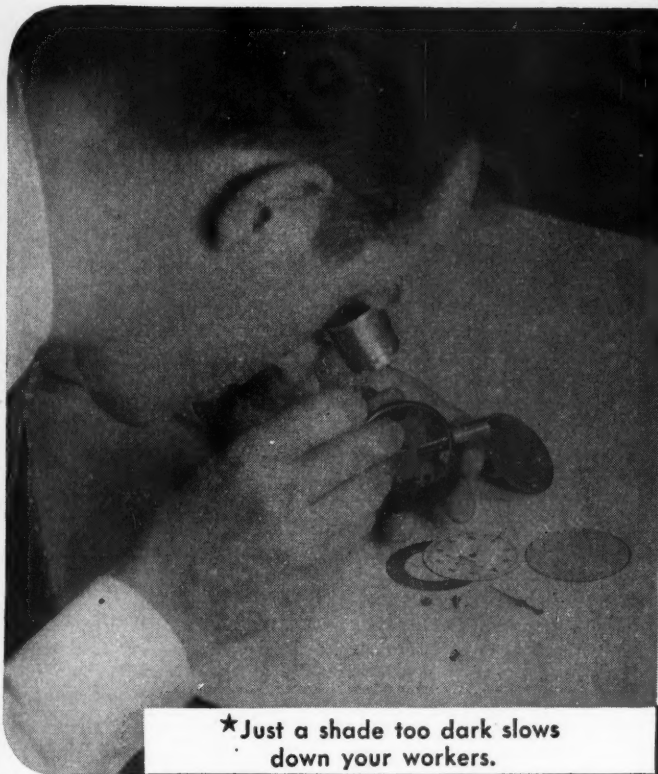


Fig. 9—All of the speed adjustment and speed regulation functions (exclusive of field weakening) either manual or automatic, as well as the current limitation, are accomplished by varying the motor armature voltage. This varying armature voltage is obtained by advancing the firing point of the rectifier tubes on the voltage wave, thus permitting only a certain portion of the alternating current voltage wave to be rectified into unidirectional voltage. From the top figure it may be seen that an alternating current voltage (supplied from a small grid transformer) is applied to the rectifier tube grid, 90 degrees lagging the anode (or line) voltage. In addition, a variable negative direct current voltage component is applied to the same grid. When the direct current voltage component is zero, an advance in the firing angle of the rectifier tube is obtained, as shown by the cross hatched area, and a high direct current voltage is supplied to the motor armature. When the direct current component is increased, negatively the firing angle is delayed still further until the voltage supplied to the motor armature is zero.

BORDERLINE VISION★

May Be Slowing Your Workers



You Can Speed Up Production With Wheeler Skilled Lighting!

Lighting that's just a shade too dark or too glaring is hard to spot at a glance. But...

Borderline Vision in many a plant means little, individual production slowdowns. Little slowdowns because a careful worker has to look twice to do the job right - because a careless worker may look once and do it wrong. Little slowdowns that add up to an expensive lag in your production.

That's why better, faster work is almost automatic when you put in Wheeler Skilled Lighting. For 64 years Wheeler has specialized in light engineering. Wheeler units are designed to *control* light - to get maximum illumination from standard lamps. Their high reflection factor puts light to work where it belongs: on the job. And their rugged, porcelain enamel-coated construction means longer service and easier maintenance.

That's why it will profit you to write today for catalogs giving full details on the complete line of Wheeler Fluorescent and Incandescent Reflectors. Wheeler Reflector Co., 275 Congress St., Boston 10, Mass. Representatives in New York and principal cities.

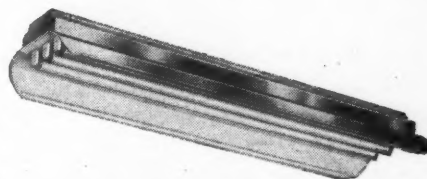
Distributed Exclusively Through Electrical Wholesalers

Wheeler Reflectors

SKILLED LIGHTING

MADE BY SPECIALISTS IN LIGHTING EQUIPMENT SINCE 1881

Electrical Contracting, June 1946



All-Steel Open-End Fluorescent Unit

Available for two or three 40-watt, or two 100-watt lamps. Broad wiring channel with accessible, enclosed ballast. Mounts from chain or conduit, individually or in continuous runs.

RLM Solid Neck Incandescent Reflector

Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. 75 to 1500 watts.





**NEEDED
ANOTHER BENDER
... GOT ANOTHER
GREENLEE**

"Back in '38 when we bought our first Hydraulic Pipe Bender, we chose a GREENLEE as we believed its heavy construction best for meeting our precise bending requirements.

"It certainly met the test over the years and when ever-increasing work called for an additional bender — naturally we got another GREENLEE."

Thus reports Contractor W. R. Grasle of Portland, Oregon. "And," he continues, "before using the GREENLEE Bender, plenty of time was needed for taking measurements on the job, delivering conduit to a shop for bending, then returning it to the job. *We've cut that labor time about 75% and we save 30 to 40% on the*

cost of fittings with the GREENLEE."

During these days when both manpower and materials are at a premium, here is the direct way to important savings. The GREENLEE Bender is *one-man-operated*, compact, portable . . . easy to carry, set up and operate when and where you want it. In but a few minutes bends pipe up to 4 1/2", rigid and *thin-wall* conduit, tubing, bus-bars.

Get complete information today on GREENLEE Hydraulic and Hand Benders and other tools for extensive time and material savings. Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 1746 Columbia Avenue, Rockford, Illinois.



OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK
Hand Benders • Joist Borers • Cable Pullers • Radio Chassis Punches • Knockout Tools • Pipe Pushers

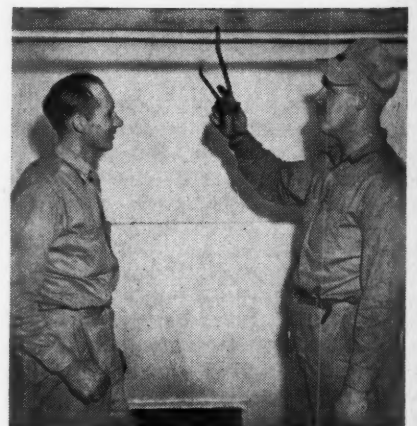
150

It will be noted that the current does not rise to its peak value instantly because of the inductance of the armature winding. The starting current will quickly reach its peak value and will drop off to the value of current that corresponds to the particular load condition after the acceleration period. If the load inertia is high, the peak current is limited only by the resistance of the armature; on the other hand, when the acceleration is controlled by the electronic control the inrush current is definitely reduced to some value that is determined by the setting of the current limiting potentiometer. It is of course apparent that the accelerating period is longer with this feature, however, the acceleration is much smoother, and period of acceleration can be controlled.

The description of the four component parts of the electronic adjustable speed drive, its application, and the control circuits has included only the basic elements for full understanding of the operation and performance of the drive. The addition of a few more circuit elements will permit motor reversal, dynamic braking, elimination of plugging and an extension of the speed range above base speed by field weakening.

The commercial control is a packaged unit, complete in itself, and includes the necessary circuits to provide adequate protection against sustained overloads, low voltage and short circuits.

The electronic adjustable speed drive is normally controlled from a remote control station which contains the necessary pushbuttons for starting, stopping and reversing and for controlling the speed.



The Phares brothers C. Arthur (left) and George E. discuss the walk-in bake oven they designed and built in their new Oklahoma City motor service shop. Arthur is in charge of the motor dept., George the transformer dept., while a third brother James A. Phares is general manager and sales engineer. The three brothers recently formed the Southwest Electric Co., constructed a huge building in Oklahoma City and are now ready to specialize in large motor and heavy transformer repairs.

Electrical Contracting, June 1946

FIRST To Be Approved By Underwriters' Laboratories



*the Weakest Link
must be the Safest!*



ECONOMY—
Renewable Cartridge Fuses and
"Drop Out" Renewable Links



CLEARSITE—
Plug Fuses—shows when
blown



ECO—
Non-Renewable—Non-Indi-
cating Cartridge Fuses



ARKLESS—
Non-Renewable Mechanical
Indicating Cartridge Fuses

Time Tested Electrical Fuses

SOLD THROUGH JOBBERS EXCLUSIVELY SINCE 1911.

ECONOMY Fuse and Mfg Co.

2717 N. Greenview Ave., Chicago 14, Illinois
Representatives in all principal cities.

1335

RANGE OUTLETS

ARROW

3-Wire, 50 Amp., 250 V.



Upper figure: Range Cap No. 7952 of polished black Bakelite, designed to match the Receptacles. Lower left: Range Outlet No. 7950, surface type; polished black Bakelite. Also available in white Ivorylite: No. 7950-I. Lower right: Range Outlet No. 7987, flush type; polished black Bakelite. If wanted with .040" brush brass plate, specify No. 7990; with .060" plate, No. 7991.

with 90°-angle

RANGE CAP

These quickly-wired Outlets and Caps have every improved feature for easy installation *and use*. Straight-in wiring with solderless connectors make fast work of range hook-ups. *Surface* Range Outlet No. 7950 has built-in cable clamp interchangeable for back or bottom wiring. 2-screw contacts; $\frac{3}{4}$ " and 1" knockouts provided. *Flush* Range Outlet No. 7987 (with 2-screw contacts) is designed for 4" or 4 $\frac{11}{16}$ " box and standard $\frac{3}{4}$ " plaster cover. Requires no special attachments. Grounding slots and contacts in the plate.

Both the surface and flush types take Range Cap No. 7952, for straight-in wiring and solderless connections. Built-in cable clamp eliminates awkward right-angle cable connections. Adapted for use with 3-wire all-rubber cable as well as metallic or non-metallic sheathed cable. Ground straps on Cap connect with ground clamp on Receptacle for easy and secure ground connections. Cap and Receptacle combination make a neat, compact installation with attractive harmony of design.

DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

ARROW ELECTRIC DIVISION



THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.

QUESTIONS ON THE CODE

MOTOR SWITCH

Q. Why does the Code allow the lower horsepower rated switches for motors when using super lag fuses: as 5 hp. rated switches for 7½ hp. motors?—M.R.

A. The Code does not permit a 5 hp. switch to be used on a 7½ hp. motor. Section 4383 definitely states that a motor controller shall be of a horsepower rating not lower than the horsepower rating of the motor. When fuses not having time-lag are used for the protection of a motor branch circuit, it must be of about 300 percent of the motor rating in order to take care of the starting current of the motor. This quite generally meant that the fuseholder would have to be of the proper rating to accommodate these fuses. This often resulted in larger fuseholders and thus larger switches than would otherwise be necessary.

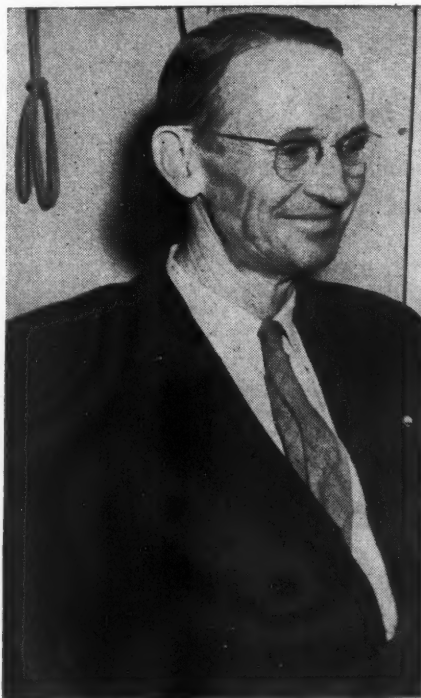
Where time-lag fuses are used however, the fuses need be not over 125 percent of the full load ampere rating of the motor and this means that a fuseholder of smaller size could be used. This often resulted in the use of a switch of less ampere rating but the horsepower rating of the switch must not be less than that of the motor.—F.N.M.S.

JUNCTION BOXES

Q. I have installed junction boxes in the attic for splicing and future taps. They are accessible by way of a removable ladder without removing any part of the building structure. The local inspector says these boxes are not accessible. Is he right?—A.S.B.

A. If the inspector is referring to the National Electrical Code, he has apparently become confused over the definition of "readily accessible" as Section 3713 of the N. E. Code states that "Junction boxes shall be so installed that the wiring contained in them may be rendered accessible without removing any part of the building." Therefore an

attic to which access may be had by means of a trap door would be considered accessible even though a ladder had to be obtained to reach the trap door. Under Section 2351 the N. E. Code requires that the service equipment be located at a readily accessible location and the Code definition of the term "readily accessible" reads as follows: "Capable of being reached quickly for operation, renewal or inspection, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc." For some reason the terms "readily accessible" and "rendered accessible" have caused confusion to many.—G.R.



A stickler for rigid inspection and adherence to code rules, John H. Cannon, chief electrical inspector of the City of Tulsa, Oklahoma, is the contractor's friend. During the critical conduit shortage "era" (Tulsa is a rigid conduit city), many contractors were able to "keep going" through his permission to install used conduit—provided it was swabbed, rough edges filed, and threads re-run.

"T" RATED SWITCHES

Q. Is it true that snap switches controlling tungsten filament lamp loads must be of the "T" rated type?—P.H.

A. Interim Amendment No. 57 approved August 11, 1942 states that snap switches controlling tungsten-filament lamp loads and combined tungsten-filament and non-inductive loads shall be of the "T" rated type except where the three following qualifications are satisfied: "1. If switches are used in branch circuit wiring systems in private homes; in rooms in multiple-occupancy dwellings used only as living quarters by tenants; in private hospital or hotel rooms; or in similar locations but not in public rooms or places of assembly; and 2. Only when such a switch controls permanently connected fixtures of lighting outlets in one room only or in one continuous hallway where the lighting fixtures may be located at different levels or on porches or in attics or basements not used for assembly purposes; and 3. When the switch is rated at not less than 10 amperes 125 volt; 5 amp., 250 volt; or for the four way types, 5 amp., 125 volt; 2 amp., 250 volt."—G.R.

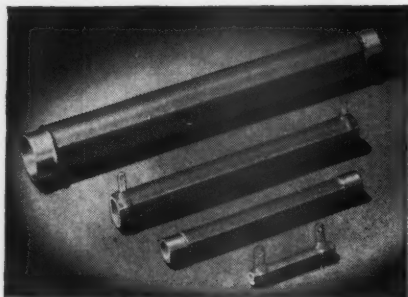
HOW MANY CIRCUITS

Q. Does the Code still hold us to four 2-wire circuits or three 3-wire circuits?—G.K.

A. The intent of this question is not quite clear. The Code does limit the number of circuits which may be used.

There are however, some limitations which may have been in the mind of our inquirer. The number of wires in a conduit are limited to 9. This would mean that not more than four 2-wire circuits, three 3-wire circuits, nor more than two 4-wire circuits could be contained in any one run of conduit (Sect. 3466. 3487).

FOR VHF CIRCUITS YOU WANT THIS RESISTOR . . .



Ward Leonard Non-Inductive Bulletin 21 Resistors were designed especially to meet the exacting requirement of high-frequency applications. The unique design of the Ward Leonard Refractory accurately fixes the points at which the Ayrton Perry Windings cross. This reduces inductance and distributed capacitance to an absolute minimum. Bulletin 21 Resistors are Vitrohm Resistors with the desirable characteristics of all Ward Leonard Vitrohm Resistors.

WARD LEONARD ELECTRIC COMPANY

28 SOUTH STREET, MOUNT VERNON, N. Y. • OFFICES IN PRINCIPAL CITIES



Available in a wide range of sizes and resistance values, with ferrule or tab terminals. For further information see Bulletin 21.

Write for Bulletin 21 today

WARD LEONARD
RELAYS • RESISTORS • RHEOSTATS
Electric control devices since 1892

Skilled Lighting FOR SAFER LIGHTING

Wheeler DUST-TIGHT Fluorescent Lighting Units



FOR HAZARDOUS LOCATIONS

For "Skilled Lighting"—plus safety—use Wheeler DUST-TIGHT Fluorescent Fixtures. They meet Underwriters' requirements for Class II, Group C and F, and Class III and IV Hazardous Locations. They bring 64 years of engineering experience in safe lighting to many other locations where lamps, sockets and reflecting surfaces must be protected from non-combustible dusts and vapors. Class II-G DUST-TIGHT Units are

all-steel construction. Made in two and three lamp 48", 40-watt units. Available with Water-White Plate Glass, Tempered Clear Safety Plate Glass or Double Thick Plain Clear Glass and hinged, dust-tight covers.

Write for complete data sheet. Wheeler Reflector Company, 275 Congress Street, Boston 10, Mass.; New York, N. Y. Representatives in principal cities.

Distributed Exclusively by Electrical Wholesalers

Wheeler

**REFLECTOR
COMPANY**

Lighting Equipment Specialists Since 1881

In a metal surface raceway the number of wires is limited to 10. This would allow five 2-wire circuits, three 3-wire and two 4-wire circuits (Sect. 3524).

With underfloor raceway and cellular metal floor raceway the number of wires is not limited except that the combined cross-sectional area of all the wires must not exceed 40 percent of the interior area of the raceway (Sect. 3545 and 3564).

With wireways the number is limited to 30 (Sect. 3624).

Our inquirer, however, may have had another limitation in mind. This one is a limitation on the number of circuits and deals with the use of a "common neutral", that is, a neutral which is common to more than one circuit.

Prior to the 1940 Code, the rules permitted a neutral conductor to be used with 8 ungrounded conductors to make up branch circuits provided the neutral had sufficient carrying capacity. This would permit a common neutral with seven 2-wire circuits, three 3-wire circuits or two 4-wire circuits. Such practice now, however, is not recognized in the present Code but it should not be understood that this prohibits the use of 3- or 4-wire circuits for they are fully permissible under the 1940 Code.—F.N.M.S.

LIGHTING FIXTURES

In the March Issue of this column we stated that we found no listing of lighting fixtures for use in Class 1, Groups A & B locations.

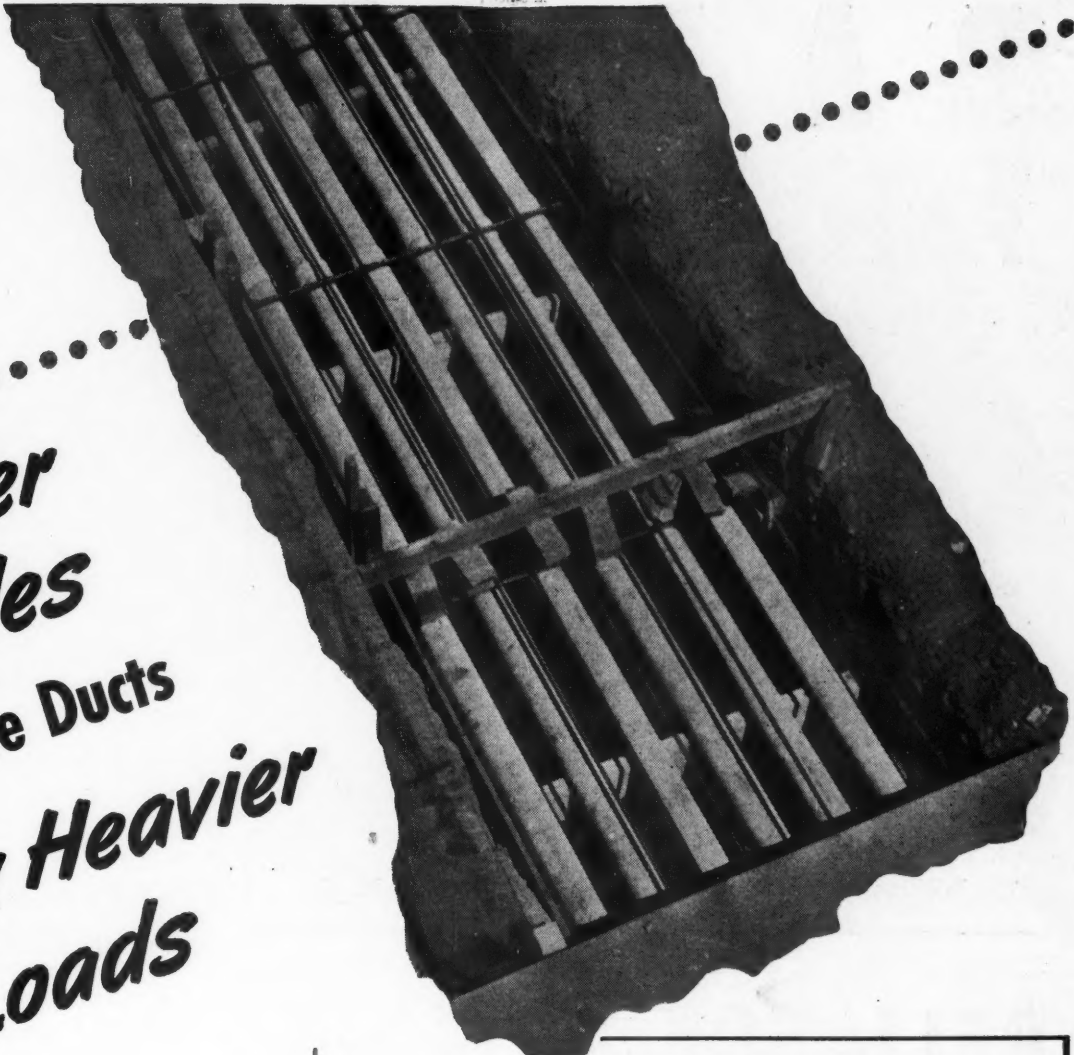
In checking this at the time, we referred to the May, 1945 List of Inspected Electrical Equipment.

We have since found that in June, 1945, a listing was given to Explosion-Proof Lighting, Inc., New York, N. Y., of fixtures for Class 1, Groups A & B. One is for 75 to 100 watts and another for 150 to 200 watts. Also in February 1946 similar listing was given to Safe Lighting, New York, N. Y.

They are designed for operation with air pressure in the lamp compartment, to prevent entrance of surrounding hazardous atmospheres and are to be removed from the hazardous area for relamping and for the introduction of air under a pressure of not more than 11 pounds per sq. inch.—F.N.M.S.

GROUNDING

Q. If the grounding of the frame of an electric range to the neutral conductor is proper, why does the inspector insist that I run a separating grounding conductor from the grounded neutral at the service to ground the con-



Cooler Cables in Transite Ducts Carry Heavier Loads

Increases of as much as 15% in current carrying capacity have been measured in cables sheathed in Transite Ducts!

The figures in the test case illustrated, made by Johns-Manville Research Engineers in collaboration with several leading cable engineers, apply to a single Transite Duct compared with an organic duct.

Transite Ducts have been proved to dissipate I²R losses 13% faster than other ductways tested, thus keeping cables cooler. Higher load capacity, reduced copper losses and increased cable insulation life are the results.

Made of asbestos and cement, Transite Ducts are strong, immune to rust and rot. They are incombustible and unaffected by electrolysis or galvanic action. A permanently smooth bore makes possible long cable pulls and easy replacements. Long, lightweight lengths can be quickly and economically installed. In addition, a full line of fittings simplifies even the most complicated installations.



HOW TRANSITE DUCTS INCREASE CABLE CARRYING CAPACITIES

Tests made on a lead-sheathed 500,000 CM cable insulated with 1/2" paper and placed inside a single duct encased in concrete.

Sheath Temperature, 145° F.
Ambient Air Temperature, 90° F.

CURRENT CARRYING CAPACITY

Transite Duct	796 amperes
Organic Duct	691 amperes
Difference	105 amperes

(Figures are results of tests conducted in the J-M Laboratory in collaboration with several leading cable engineers.)

For full information on Transite Ducts, write for Data Book DS-410. Johns-Manville, Box 290, New York 16, New York.

Johns-Manville

TRANSITE DUCTS

CONDUIT for use without concrete
KORDUCT for concreting in

PARTS

FOR FANS MOTORS CONTROLS

PROMPT SHIPMENT FROM LARGE STOCK

AUTHORIZED PARTS DISTRIBUTOR

Brown-Brock-
meyer
Century
Cutler-Hammer
Delco
Diehl
Duro
Emerson

General Electric
Hamilton-Beach
Holtzer-Cabot
Howell
Hunter
Ilg
Leland
Marathon

Master
Peerless
Robbins & Myers
Star
Thor
Wagner
Westinghouse

READING ELECTRIC COMPANY, INC.

Parts Distributors for the Manufacturer

200 William St.

Barclay 7-6616

New York 8, N. Y.

RELIANCE AUTOMATIC TIME SWITCHES



Model "W"

Completely automatic
... extremely simple,
compact, economical
... three types cover
practically every re-
quirement ...

ASTRONOMIC TIME SWITCH

• The Model "W" Astro-
nomic types are particu-
larly popular for advertis-
ing illumination. The "on"
operation changes daily to
correspond with local sun-
set time, eliminating the
necessity of re-setting the
dial as the days become
longer or shorter.

AMERICA'S RELIABLE 24 hour-a-day GUARDIANS

RELIANCE Time Switches have proved their dependability. They give complete and reliable service under many varied conditions—a factor of paramount importance when constant good service is essential. Send for catalog and price sheets for complete details.

RELIANCE AUTOMATIC LIGHTING CO.

1907 MEAD STREET

RACINE, WISCONSIN

duit extending into the hay mow in a farm barn? This conduit run is installed only to provide protection for a non-metallic sheathed cable supplying a light outlet, and in the past I have grounded this conduit to the neutral at the light outlet box in the hay mow. The lower end of this conduit terminates with only a bushing.—M.S.

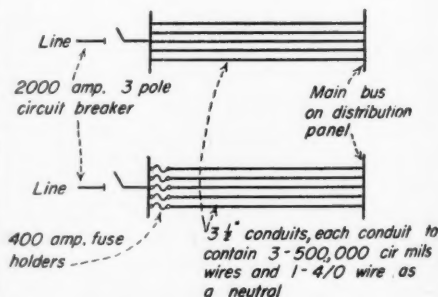
A. The N. E. Code under Section 2533 requires that such conduit runs be grounded if over 25 feet in length or if within reach of grounded surfaced or other grounded mediums. Then Section 2555 states that grounding of such short sections shall be accomplished either by a separate grounding conductor, or if special permission from the authorities having jurisdiction can be first obtained, other means of grounding may be used. Therefore the inspector was complying with the Code in requesting the use of a separate grounding conductor.

This is not a proper answer to your question, but the answer can only be given by the Code Committee so I have not attempted to explain why it is all right on a range but not elsewhere.—G.R.

CONDUCTORS IN MULTIPLE

Q. I want to install a 3 phase 4 wire feeder consisting of five $3\frac{1}{2}$ in. conduits, each containing three 500,000 cir. mils Type R. H. wires, and one 4/0 Type R. H. wire as a neutral.

I want to connect the five cables in parallel per phase. Is it necessary to insert fuses in the circuit as shown on the sketch, or can they be cut in solid?—J.J.



A. Where conductors are run in parallel, each of the wires which are paralleled must be of the same size and all of the wires of one leg must be connected together at each end so as to be both mechanically and electrically secure at the terminals. It would not be permissible to parallel wires of different sizes.

Each separate conductor should not be separately fused, but the whole parallel leg should have overcurrent pro-

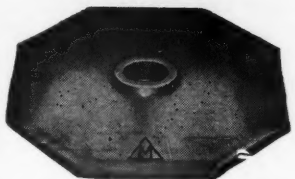
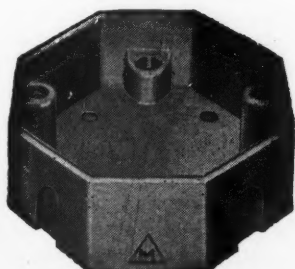
ILLINOIS PORCELAIN WIREHOLDER INSULATORS

Insure
**SAFE
HOUSE SERVICE
CONNECTIONS..**

• When you use Wireholder Insulators with the name "ILLINOIS" you are backing up your work with the right quality for the job.

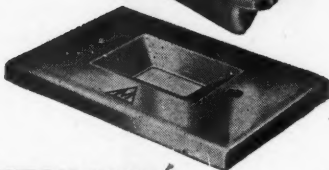
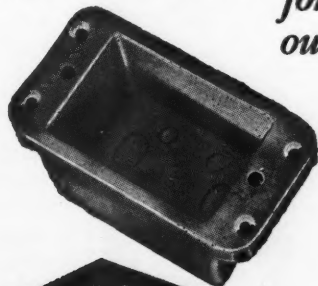
All corners are rounded to prevent injury to the insulation of the wires. The screws have deep, sharp threads for easy installation. The screws are fastened into the insulators with non-shrinking metal alloy. The all-steel screws are hot galvanized by a special process to insure a smooth, even coating. Will not cause rust streaks on the sides of buildings. These dry process wireholders are made in sufficient styles and sizes to meet all requirements. Wet process porcelain supplied on special order.

OUTLET BOXES



Glazed and unglazed styles conforming to all existing standards of dimensions, spacing, position of knockout holes, and mounting screws. High mechanical and electrical efficiency.

ALL-PORCELAIN ILLINOIS SYSTEMS



SWITCH BOXES

Insure greater safety in wiring and the elimination of all grounding hazards. Made of the best quality of white porcelain. Metal inserts are placed in two holes of the switch boxes for receiving screws of standard switches, plug outlets, etc. Knockouts for single wires, also for cables. Specify and use them.

*for
outstanding, adequate and
modern wiring jobs*



KNOB

Cement coated — extra length nail — genuine leather washer — code standard. They don't chip when driven in and they do stay in place and have a firm grip. Available in a wide variety of heights, diameters, holes, and grooves.

STANDARD TUBES

In sizes 1/2 to 48 inches, 5/16 to 3 inches diameter in following types: unglazed, glazed, split, floor, split floor, headless, curved and, crossover split, and cross over. Diameters all uniform both inside and outside.



ILLINOIS ELECTRIC PORCELAIN COMPANY *Macomb, Illinois*



When the job calls for a new COMMUTATOR — there should be no question for the source—just 'phone, wire or write us.

• **3 FACTORIES** to serve you. •

TOLEDO STANDARD COMMUTATOR CO. — Toledo 6, Ohio

HOMER COMMUTATOR CORP. — Cleveland 3, Ohio

HILLSDALE COMMUTATOR CO. — Hillsdale, Michigan

THE NATION'S LARGEST EXCLUSIVE MANUFACTURERS OF QUALITY COMPUTATORS

LUMINITE
REG. U. S. PAT. OFF.

FOR BOTH SINGLE AND MULTI-GANG SWITCHES

LISTED BY UNDERWRITERS LABORATORIES, INC.

NATIONALLY ADVERTISED IN LEADING MAGAZINES

WIRING TERMINALS FOR EASY INSTALLATION

UNCONDITIONAL RENEWAL GUARANTEE

BEAUTIFULLY STREAMLINED IN GENUINE PLASKON

LITERATURE AND DISPLAY HELPS

Automatic Switch Light!

The tiny shielded electric light is *always on* when the room is dark — *always off* when the room lights are on. Ends fumbling for switches. No more smudged walls. Single-gang, two-gang, and multi-gang assemblies available. Operates for less than 2c per year. Works also on 3- and 4-way switches. Guaranteed. For steady profits, sell the *original* LumiNite. List price \$1.00. Write for details.

ASSOCIATED PROJECTS CO., 80 E. Long St., Columbus 15, Ohio

tection. In the example set forth above, the 2000 ampere circuit breaker provides the required overcurrent protection.

If each conductor were to be separately fused, it would be necessary to fuse each one at each end in order that it could not be overloaded through a back feed. With the extra secure connections required at the terminals, it is expected that the load will be evenly distributed among the paralleled wires so that any one of them will not carry an excess.

In the 1946 Code the number of wires which may be connected in multiple will be limited in accordance with the size of the wires. For instance not more than three No. 1/0, four No. 2/0 nor less than five No. 3/0 to 500,000 c.m., may be paralleled. The thought here is that a short circuit on any one of the conductors will open the overcurrent device, rather than burn out the cable.—F.N.M.S.

GAS STATION WIRING

Q. One of our competitors is wiring a filling station and is burying a single conductor under the driveway for various circuits. The insulation is just rubber without braid of any kind. Does the Code approve the use of such an insulation underground?—A.B.H.

A. The N. E. Code simply states that conductors used underground shall be approved for that purpose. This statement is found under Section 3035. There are several companies that manufacture an approved underground conductor which is not covered with a braid of any sort, and possibly the installation in question has been made with an approved type of single conductor suitable for use when buried in the ground. This may be readily determined by examining the tag attached to the reel or coil as the Underwriters' Laboratories label of approval will bear the letters U.S.E. on either single or multiple conductor cables approved for use underground in direct contact with earth. If this tag is not available, a small sample of the conductor can be readily identified should you care to submit it.—G.R.

DUSTY LOCATION

Q. We are about to wire a milk drying plant and would like to know whether or not it would be considered as a dusty location?—H.P.

A. This is a question that must be answered by authorities having jurisdiction over electrical installations

MAILING LISTS THAT WORK . . .

McGraw-Hill Industrial Mailing Lists are a direct route to today's purchase-controlling executives and technicians in practically every major industry.

These names are of particular value now when most manufacturers are experiencing constantly increasing difficulty in maintaining their own lists.

Probably no other organization is as well equipped as McGraw-Hill to solve the complicated problem of list maintenance during this period of unparalleled changes in industrial personnel. These lists are compiled from exclusive sources, based on hundreds of thousands of mail questionnaires and the reports of a nationwide field staff, and are maintained on a twenty-four hour basis.

Investigate their tremendous possibilities in relation to your own product or service. Your specifications are our guide in recommending the particular McGraw-Hill lists that best cover your market. When planning your industrial advertising and sales promotional activities, ask for more facts or, better still, write today. No obligation, of course.

for Results

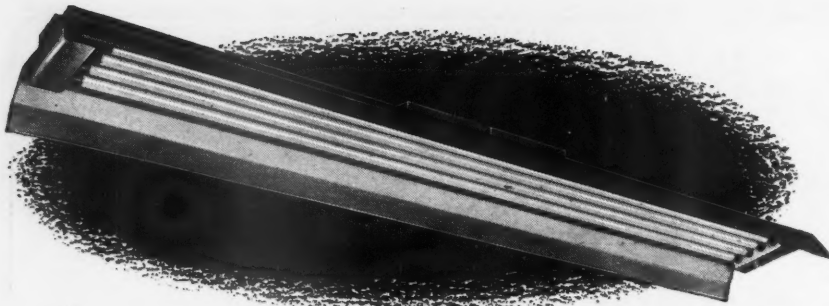


Mc GRAW-HILL
DIRECT MAIL LIST SERVICE

McGraw-Hill Publishing Co., Inc.
DIRECT MAIL DIVISION

330 West 42nd Street

New York 18, N. Y.



*COLOVOLT COLD CATHODE INDUSTRIAL FIXTURES

Here is the new Colovolt industrial fixture, one of a complete line of industrial and commercial "packaged" units. Equipped with the standard 93" Colovolt 10,000 hour lamp, Colovolt fixtures may be used singly or in continuous line lighting in multiples of 8 feet. Instantaneous starting, no flickering, guaranteed for 1 year ex-

cept for failure due to breakage are extra advantages of the Colovolt Cold Cathode low voltage fluorescent lamp. The long life expectancy of Colovolt lamps may be realized even when constantly turned on and off, and *pre-scheduled re-lamping, with no loss of production or time, is now possible with Colovolt installations.*



*Trade mark registered U. S. Pat. Off.

Contact your electrical wholesaler or jobber, or write us for full details and prices.

GENERAL LUMINESCENT CORPORATION

672 S. FEDERAL STREET

CHICAGO 5, ILLINOIS

Electricity



FOR ANY JOB—ANYWHERE

ONAN ELECTRIC GENERATING PLANTS supply reliable, economical electric service for industrial uses, as well as for scores of other general applications.

Driven by Onan 4-cycle gasoline engines, these power units are of single-unit, compact design and sturdy construction. Suitable for mobile, stationary or emergency service.

Capacity range: 350 to 35,000 watts; 115 to 660 volts A.C.; 50 to 800 cycles; 6 to 800 volts D.C.; combination A.C.—D.C. types.



Model shown is from W2C series: 2000 to 3500 watts, powered by Onan two-cylinder, water-cooled engine.

D. W. ONAN & SONS

2116 Royalston Ave.

Minneapolis 5, Minn.

in your city. In the first place, methods used in drying milk are varied and the percentage of butter fat and moisture left in the finished product will have a direct bearing on its explosibility. The U. S. Department of Agriculture ratings on the explosibility of dried milk indicate that it varies from 2 to 7. A rating of 0 would indicate a safe dust and a rating of 10 indicates a maximum explosive. On these tests the milk powders used contained a minimum amount of moisture.

Therefore it is evident that a plant drying skim milk would be much more dangerous than one drying whole milk. Any rooms or areas in which there is evidence of dust being in suspension should, of course, be considered as a Class 2 location.—G.R.

STRAPPING CONDUIT

Q. How far from strap to strap for $\frac{1}{2}$ inch conduit—for instance: from outlet to outlet is 10 ft. Is one strap in center sufficient?—G.K.

A. The Code does not specify how, when or where conduit shall be strapped in place. Section 3040 requires that all raceways shall be secured in place and section 1105 states that they shall be carefully secured in place and attached to fittings. Section 1106 helps out a little by requiring that electrical equipment be firmly secured to the surface on which it is mounted and that wooden plugs in masonry, plaster or concrete are no good.

If the outlet boxes are securely fastened in place, one strap in the center of a 10 foot run is generally sufficient.—F.N.M.S.

FLUORESCENT FIXTURES

Q. We have just finished a remodeling job in which two different types of fluorescent fixtures of the plug in type were hung. Some of these fixtures came with three conductor cords and the rest had two conductor cords. Those equipped with the third conductor used it as a grounding wire. Were they especially wired for a certain specific use or are there some places that require such grounding?—H.H.

A. All plug in type fixtures constructed of conductive materials which are supplied from a metallic raceway wiring system must be grounded. See Section 4127. The manufacturer producing the fixture with the three conductor cord was simply complying with this section of the National Electrical Code. Metal fixtures of the plug

in type which are supplied from a knob and tube or other nonmetallic wiring installation operating at not over 150 volts to ground need not be grounded unless they are mounted on metal or metal lath ceilings or walls and are not insulated therefrom, or are within reach of plumbing fixtures, piping or other grounded mediums.—G.R.

TYPE SN CONDUCTORS

Q. Will you advise me if three No. 8 stranded SN wires, diameter .246, area .0475 each, can be installed in an existing $\frac{1}{2}$ inch conduit?—F.E.H.

A. No. This is covered in Interim Amendment No. 46 to Section 3005 which requires that Type SN conductors in size No. 14 to No. 8 inclusive, when used for new work in raceways, shall be installed in accordance with Table 6 on Page 308. Table 6 requires $\frac{3}{4}$ inch conduit for three No. 8 wires.

If all of the conditions mentioned in Section 3005e are present (i.e. increased load is present, space is not available in raceways for wires with regular thickness of insulation and the size of raceway cannot be increased because of structural conditions) then Table 7 can be used and $\frac{1}{2}$ inch conduit would be permissible.—F.N.M.S.

SN CONDUCTORS

Q. Under Notes Table 15, does the Code recognize SN conductors, stranded or solid from sizes 14 to 8?—F.E.H.

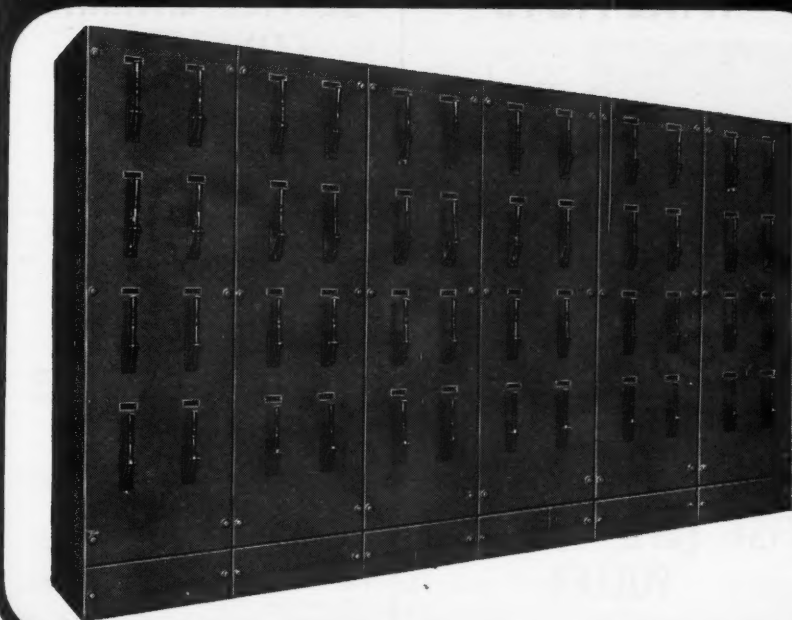
A. Yes.—F.N.M.S.

LIGHTING FLOUR BINS

Q. We plan to revamp the electrical installation in a small flour mill, and the owner has asked us to install permanent lighting fixtures in the ceiling of the flour bins. There is some doubt in our minds concerning the advisability of placing lighting fixtures in these bins. Would the Code permit them?—S.J.

A. The fine print note under Section 5060 recommends that lighting fixtures intended for the illumination of bins be of dust-tight construction so mounted that the fixture will be flush with inner surface of the bin and protected against mechanical injury. No permanent wiring or fixtures should be permitted inside the bin. The flush type fixture is considered safer than the usual extension lamp which is used in most flour mills.—G.R.

You're sure that it meets
EVERY REQUIREMENT~



when—
your Switchboard is produced by
Pelham

We take full responsibility for meeting all specifications of architects and engineers . . . as well as municipal, state and federal requirements. You are completely relieved of all such detail work when your switchboard is designed and built by Pelham.

Exceptional Engineering Service. No matter how difficult your problems of design may be, our engineering department has probably met and solved them, in our wide experience.

Nothing but Highest Quality. All Pelham equipment is built with the best of materials and workmanship.

Dependable Service. Our deliveries are made when promised.

PELHAM ELECTRIC MANUFACTURING CORP., ERIE, PA.

SPECIALIZED DESIGN

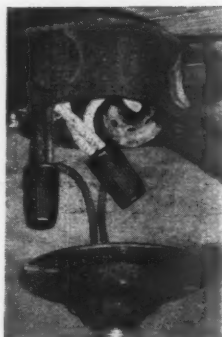
Pelham
UNEXCELLED QUALITY

SWITCHBOARDS • PANEL BOARDS • SWITCH GEAR AND ACCESSORIES



HOUSE WIRING SPECIALS

"WIRE-NUTS"



For hundreds of various house and other wiring jobs, IDEAL wire connectors provide the modern way to make quick, safe, easy and lasting joints. They are easy to use—you simply (1) strip wires, (2) screw on—that's all! And, you have a wire joint that's better electrically, stronger mechanically. They eliminate the

fuss and bother of old fashioned solder-and-tape and blow-torch methods. All you need is a wire stripper and a pocketful of "Wire-Nuts". Made in five sizes for all solid and stranded wire combinations from No. 18 to 3 No. 10. FULLY APPROVED. Millions in use!

FISH TAPE, REEL AND PULLER



No more worry about Fish Tape getting loose and springing all over the floor. With the IDEAL Fish Tape Reel, it is easy to pull tape through conduit quickly.

While the coil of steel tape is held securely in the reel at all times, it can be instantly and quickly run out to any length, with constant tension on the wire being maintained—no kinks, bends or breaks.

The Fish Tape, Reel and Puller is three tools in one; belongs in every Electrician's Kit along with pliers, cutters and screw driver. Made in 8 convenient sizes.

B-X ARMOR CUTTER



B-X cable (either two or three wire, No. 12 or No. 14) is easily and quickly cut in one snip with this handy new pocket size tool. The B-X Armor Cutter eliminates antiquated, dangerous hack saw methods. This tool cuts cleanly, without injury to insulation. Has a special steel cutting blade removable for sharpening.

SERVICE ENTRANCE CONNECTORS



Especially efficient for making connections between service drop conductors and house entrance leads. The body is made of cold drawn copper; the screws of Everdur. These service entrance connectors take wire Nos. 2 to 10 stranded, and No. 12 solid. Easily applied with a screw driver or pliers.

"SCREW-TITE" SOLDERLESS LUGS

Can be quickly and securely attached with either screw driver or wrench. "Screw-Tite" lugs require no solder—no special application tools.

Made of seamless electrolytic copper, accurately pressed for uniform size. Heavy brass, checkproof shell reduces heating.

Flat contact surfaces assure minimum resistance, with full carrying capacity evenly distributed from wire to lug. There is no metal cut away to reduce capacity. Made in 8 sizes for No. 14 wire to 2,000,000 CM cable (35 to 1050 amps.) Special "screw-tite" lugs are available.



CABLE RIPPER

Cuts non-metallic sheathed duplex cable or lead covered cable—cleanly, quickly, easily, in one simple operation. Case hardened cutting point provides positive, clean ripping by simply squeezing cable ripper on cable and pulling.

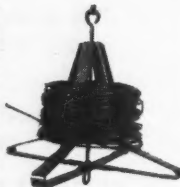
Can also be used for ripping outer sheathing of other cords, lead cables, etc., where outside diameter is not greater than $\frac{3}{8}$ ". Overall length $3\frac{3}{4}$ " — weight 2 ounces.



WIRE and CABLE REEL

Easily hangs anywhere — from joist, pipe beam or wherever it is handy, giving the workman complete control of coiled wire or cable. Steel frame is designed with one part of the frame smaller than the other, so that when Reel is folded it requires no more room than an ordinary coat hanger.

A finger locking device holds Reel open or closed. Handles practically any type of coil from 3" to 14" inside diameter, insulated wire from No. 18 to No. 2, electrical cord, rope, armored cable, romex, binding, etc.



SPLIT BOLT CONNECTORS

These new IDEAL Split Bolt Connectors are made of either high quality bronze, brass or aluminum. They have precision contact surfaces, to produce maximum conductivity. They are used for permanent or temporary solderless connections.

Available in Two Types—"one piece" and "two piece" with small or large heads. On the "one piece" type of flexible link permits universal movement of the nut. The nut swings entirely clear of the slot, eliminating interference with wires during installation.



JOIST BORING MACHINE

No more climbing up and down ladders, no more back breaking stooping or straining. This IDEAL Joist Boring Machine bores through rafters, joist or studding up to height of 11 feet or bores below floor level. Bit locks into position with a knurled collar. Weight 11 lbs. The joist borer is now available "knocked down" without pipe to assemble on the job. Either standard $\frac{1}{2}$ " pipe or conduit can be used.

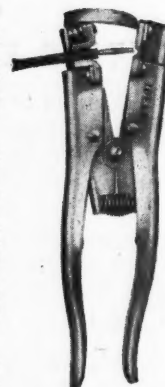


"E-Z" WIRE STRIPPERS

Here is a handy wire stripper. Pocket size, only $7\frac{1}{2}$ inches long—weight 24 ounces. "E-Z" Wire Strippers come in 2 models. "Automatic" and "Standard".

Operating on the triple action principle, the "Automatic" model clamps the wire, cuts insulation and strips it, all in one simple operation. A lever stops the return of the arms until the wire is removed, after stripping. Strips stranded wire but can be used equally well on solid wire.

"Standard" Model does not have "return lever". It is particularly suited for stripping solid wire, but can be used for stranded wire. Five sizes strip No. 30 to 8 gauge—solid or stranded wire.



SOLD THROUGH ELECTRICAL WHOLESALERS
IDEAL INDUSTRIES, INC.

Successor to Ideal Commutator Dresser Co.

1041 Park Ave.

Sycamore, Ill.

IN THE NEWS

HOUSING ORDER SUPPLEMENTS ISSUED

Two supplements to Veterans' Housing Program Order 1 (VHP-1, March 26, 1946) have been issued by Civilian Production Administration. One, dated May 2, 1946, (Supp. 1 to VHP-1) is in the form of an interpretation of paragraph (b) (3) of VHP-1, and more fully defines and lists "fixtures and mechanical equipment", both coming within the terms, and excluded from the terms of the order. The other, dated May 14, 1946, (Supp. 2 to VHP-1), explains certain provisions of the order, and gives examples, relating to "beginning construction".

Order VHP-1, dated March 26, 1946, restricts the installation of fixtures and mechanical equipment, whether or not alterations to the structure are involved. It defines a fixture as "any article attached to a building or structure and used as a part of the building or structure". It also defines mechanical equipment as "any equipment which is used to operate a building or other structure." Supp. 1 to VHP-1, issued May 2, 1946,

contains considerable information of interest to the electrical construction industry. Paragraphs (b) (1) and (b) (2) are quoted in part below:

"(b) *Fixtures and mechanical equipment.* (1) The following articles are considered fixtures and mechanical equipment if they are attached to a building or structure by nails or screws, if they are connected with the plumbing or other piping system of the structure (except by connection to an existing outlet without installing new wires or a new outlet), if a base or foundation is built for the item, or if the item is cemented to the building or structure:

Air conditioning equipment (except when used for humidity or temperature control in industrial processing or as refrigeration equipment in a cold storage warehouse or a frozen food locker plant and except self-contained individual units with no duct systems).

Lighting equipment
Signs, electric and other
Ventilating equipment

(2) The following articles are never considered fixtures or mechanical equipment:

Air conditioning equipment where required to provide humidity or temperature control for industrial processing and self-contained individual units with no duct systems.

Airport equipment such as cargo and passenger handling equipment, signalling equipment, obstruction marking equipment and equipment used for lighting runways or for signalling.

Barn equipment such as milking machines, hay or litter conveyors, stanchions and stalls.

Control or testing equipment used for industrial or utility purposes or in a laboratory or hospital.

Hospital equipment such as X-Ray machines and operating tables.

Lighting equipment for floodlighting airports, railroads, or other outdoor operations.

Radio towers and other transmitting and receiving equipment.

Refrigeration equipment, such as compressors, in a cold storage warehouse or a frozen food locker plant."

Paragraph (f) of Supp. 1 to VHP-1 lists "lighting systems" and "signalling equipment", among other items, as ex-





QUIK-LABELS

Mark your wires Faster

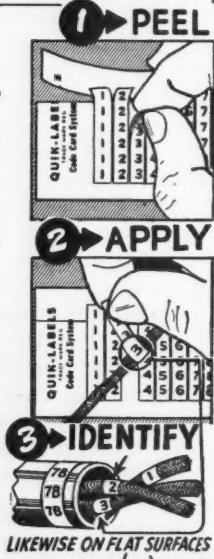
QUIK-LABELS code Wires, Leads, Circuits, Relays, Parts, etc. faster and cheaper. • Pre-cut to exact size, QUIK-LABELS come in rows on handy Cards. • Ready to use, they stick-quick without moistening, replace slow and costly string tags, roll tapes, decals, stencils, metal tabs, etc. • Silicone plastic coated to resist dirt, grease, oil, abrasion. • Removable *Self-Starter Strip automatically exposes ends of Labels for you to grasp instantly — no more finger-picking. • Time studies prove QUIK-LABELS cost less to buy-and-apply than all other markers. Maintenance men carry Cards to the job. • QUIK-LABEL Bench Dispenser (furnished gratis) holds Cards for production operators to code with both hands free. Over 165 Standard Markings in stock, including NEMA Colors.

Write for Folder and FREE Sample Cards.

W. H. BRADY COMPANY

Identification Specialists

801 N. 3rd Street, Milwaukee 3, Wis.



Bend Conduit Cold-

Here's How



Conduit can be bent



to any desired angle



without moving pipe

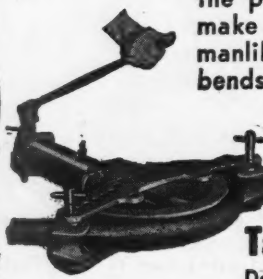


in one operation

In one single operation with Tal's Prestal Bender, you can bend pipe and conduit up to 3" in diameter.

Installation work goes faster, easier, and at a lower cost when you have a Tal's Prestal Bender on the job. This efficient, light, portable machine handles all pipe and conduit up to 3". Makes perfect bends, up to 90°, cold, in one single operation. No need to waste labor by replacing the pipe three to six times to make a bend. Does a good workmanlike job — smooth, uniform bends without kinks or wrinkles.

Simple and easy to operate. Thousands are in successful use everywhere. Write for data bulletin.



Tal's Prestal Bender, Inc.

Dept. EC-6, Milwaukee 2, Wisconsin

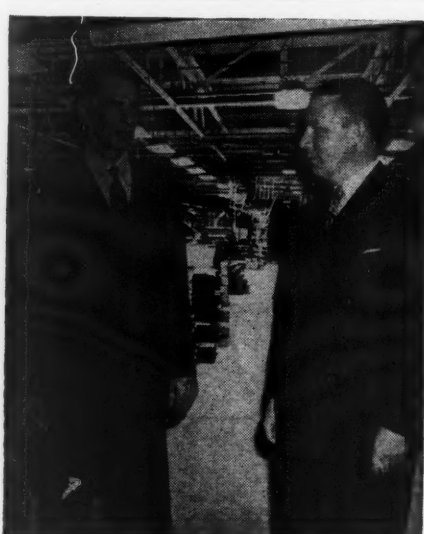
amples "of equipment exempt completely from the order if installed outside of and not attached to a building."

Supp. 2 to VHP-1, issued May 14, 1946, explains what is meant in the order by "beginning construction", and cites examples of cases "where construction has not begun" and "where construction has begun" under the terms of the order.

Copies of the order and these two supplements should be obtained if more detailed information is required.

ROCKY MOUNTAIN IAEI CHAPTER MEETINGS

Annual meetings of three chapters of the International Association of Electrical Inspectors in the Rocky Mountain States concerned themselves chiefly with a review of the changes in the 1946 edition of the National Electrical Code, presented to them by Victor H. Tousley, IAEI secretary, Chicago. Lighting, however, played a prominent part in two of the meetings, the Utah Chapter meeting at Salt Lake City, and the Montana Chapter meeting at Great Falls. At Salt Lake City, a one-day lighting conference was combined with a one-



Clarence J. Berry (left) of the Consolidated Gas, Electric Light and Power Company of Baltimore, won the first prize of \$500 in the Second Annual Commercial Fluorescent Fixture Design Competition conducted by Sylvania Electric Products, Inc., which was announced and awarded at the International Lighting Exposition, Stevens Hotel, Chicago. He also received an inscribed silver plaque for his design, which was of an unusual lighting fixture suitable for use in department stores and employing four 96-inch long slim fluorescent lamps. First prize in last year's competition was also won by Mr. Berry, who has now been named one of the judges for next year's competition. He is shown discussing the need for planned lighting layouts with Stuart Goodwillie, of Sylvania Electric Products, Inc.



C. D. Snyder (left) is the new president and general manager of The Wetherbee Electric Company, Oklahoma City, having bought out the interests of G. A. Peer (right) who will remain active with the company for a period of time. Mr. Snyder has been with the company since 1925; was vice-president since 1934. Another addition to the Wetherbee staff is R. E. "Mac" MacDowell, as chief engineer. A graduate electrical engineer, he has been head of the Electrical Section, U. S. Engineers, Tulsa, Okla., for the past six years.

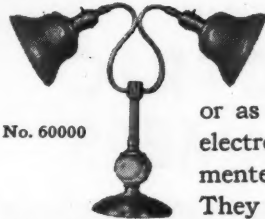
day inspectors' meeting, the former sponsored by the Intermountain Electrical Association.

D. G. Mulligan, engineer, Mountain States Inspection Bureau, chairman of the Rocky Mountain Chapter, Denver, told of the code schools which are conducted by the chapter at monthly meetings during the entire year. Meryl Mentzer, field representative, Rocky Mountain Electrical League, handling adequate wiring promotion, and Ted Foulk, Public Service Co. of Colorado, chairman of its wiring committee, addressed the noon luncheon and presented the Westinghouse-Disney film, "Dawn of Tomorrow". E. P. Hodges, meter superintendent, Public Service Co. of Colorado, Denver, was elected chairman of the chapter.

Utah inspectors were also addressed by W. L. Gaffney, secretary-treasurer, Northwestern Section, from Tacoma, Fire Chief J. K. Piercy, of Salt Lake's Fire Department, and Farrell Gunnell, U. S. Rubber Co. The program ended with a quiz session on code and ordinance problems presided over by Wm. A. Cyr, Pacific Coast editor, *Electrical Contracting*, and having as its board of experts D. J. Wolters, chief electrical inspector, Salt Lake City; Victor H. Tousley; H. G. Ufer, western superintendent, Underwriters Laboratories, Los Angeles; J. Hyde Stayner, Utah Power & Light Co.; Dan Hutchinson, Graybar Electric Co.; Douglas Peck, electrical contractor, Provo; and Lester Johnson, General Electric Co. An interesting point brought forth was that city authorities in Salt Lake City do not look with much favor upon the importation of pre-wired, prefabricated houses. Fire Chief Piercy urged closer



Lamp Ensembles



No. 60000

Twin-Light Bed-side Lamp. Adjustable ball joints.

A brand new line of beautiful matched lamps that can be sold as a complete ensemble or as individual units. All lamps are electro-plated satin chromium, ornamented in satin brass, gold lacquered. They have crystal clear decorative glass balls. Will blend perfectly with any color scheme.



No. 60001

Single Light Bed-side Lamp. Adjustable ball joint.



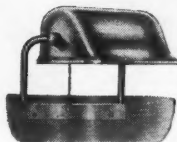
No. 65000

Floor Lamp. Inner reflector. Turn-button socket.



No. 65001

Bridge Lamp. Inner reflector. Turn-button socket.



No. 75020

Bed Lamp. One piece adjustable shade.



No. 75039

Bed Lamp. One piece adjustable shade.



No. 60003

Desk or Table Lamp with tilting harp.

The smooth finish of these handsome lamps makes them easy to clean. All are equipped with 9 feet of rubber-covered cord and unbreakable plug.

WRITE for details and prices



No. 60002

Desk or Table Lamp. Inner reflector.

Pioneers in Lighting Equipment Since 1880

Faries Manufacturing Company
DECATUR, ILLINOIS



SYNTRON

DEPENDABLE

ELECTRIC HAMMERS

**Will Drill
Cut
Channel
Chip**

**Concrete and
masonry 10 times
faster than by hand.**

Their 3600 blows per minute make short work of those tough, close-figured jobs, saving you money, time and labor.

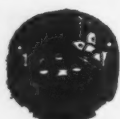
Write for data

SYNTRON CO.
690 LEXINGTON
HOMER CITY, PA.



Bakelite Boxes and Covers

CLAMPS WITH EVERY SWITCH AND OUTLET BOX



Nos.
3050 & 4050



Nos.
3051 & 4051



Nos.
3053 & 4053

Yes, with every switch and outlet box, CLAMPS so designed as to completely close knockouts, regardless of size or shape of conductor, loom or insulation. For non-metallic wiring job use U.I. Co. Bakelite Boxes and Covers. All knockouts take every, normally used, wire size.

A safe, Practical and Permanent installation.

Prompt deliveries from jobbers, centralized warehouses and our factory.



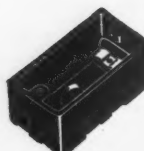
No. 5051



No. 5053



No. 5055



No. 5050

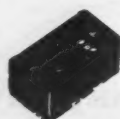


Nos.
3057 & 4057



No. 4055

AVAILABLE THROUGH YOUR JOBBER



No. 6050

**UNION INSULATING
COMPANY, INC.**

P. O. BOX 351

PARKERSBURG, W. VA.



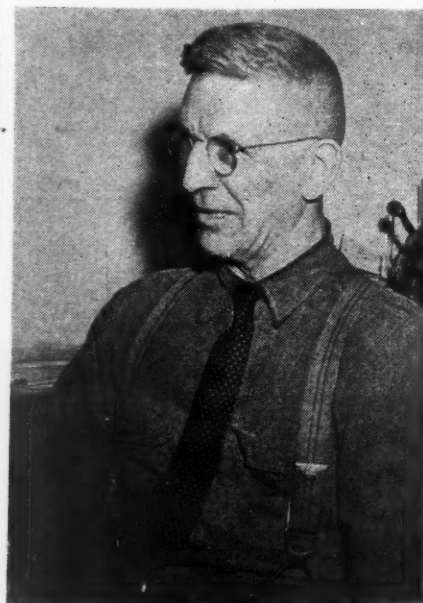
No. 7050

cooperation between electrical inspectors and fire department men making fire prevention surveys. Likewise, he urged inspectors to instruct firemen in what to look for in hazardous conditions. A resolution was passed urging study of the possibility of having a state law requiring electrical inspection. Raymond Powell, Nephi, Utah, vice chairman of the chapter, presided in the absence of Harold S. Morr, Board of Fire Underwriters of the Pacific, and was elected president at the closing session.

An evening dinner was held jointly by the chapter and the Intermountain Electrical Association, at which Elias J. Strong, manager of the latter, discussed the Handbook of Residential Wiring Design and the standards set up for the Utah and Southern Idaho territory. Elbert Kramer, Westinghouse Electric Corp., from Los Angeles, spoke on the adequate wiring program and presented "Dawn of Tomorrow".

George C. Blend, electrical contractor of Great Falls, chairman of the Montana Chapter, presided over that meeting. John W. Cromer, lighting engineer, Montana Power Co., Butte, gave a simplified review of gaseous tube and cold cathode lighting and its applications. Dr. E. W. Schilling, Dean of Engineering, Montana State College, Bozeman, explained stroboscopic effect and illustrated that where fluorescent lamps are placed on three-phase circuits, the elimination of strobe is as good as the light from an ordinary 200-watt incandescent lamp.

L. B. Johnson, General Electric Co., Salt Lake City, gave a talk on mainte-



Active in the organization of the Washtenaw County Electrical Club (Michigan) was T. C. Rohn, Rohn Electric Shop, Ann Arbor, who is secretary-treasurer of the new contractor group.



Like his dad who started the business, Wesley Evans, Salinas Electric Works, Salinas, Calif., concentrates pretty much on work around home, but during the war did many jobs even as far afield as Salt Lake City, Utah.

nance and servicing of fluorescent lighting units and circuit. The U. S. Rubber Co. paper by Fred D. Benz, of San Francisco, outlining the changes in wire insulations in the 1946 Code, was read to the meeting by W. A. Cyr in the absence of Benz. H. G. Ufer, western superintendent, Underwriters Laboratories, told of the standards and tests made on electric house heaters to assure their safety, and discussed other matters relative to fluorescent fixture approvals and the elimination of noise and heat in fluorescent units. Kramer, of Westinghouse, presented the adequate wiring story with the film.

The meeting ended by appointment of a committee headed by Dan F. Goggans, electrical contractor, Goggans & Pennie, Great Falls, to work on a program for state inspection of electrical work. K. L. Chrysler, city engineer, Billings, Mont., was elected chairman.

SWAIN WILL REPORT ATOM BOMB TEST

Electrical Contracting and the other McGraw-Hill business and technical publications will be officially represented at the atom bomb test this summer by Philip W. Swain, editor of *Power*. He will sail from Oakland June 12 on the press ship *Appalachian*, reaching Kwajalein Island June 28 and Bikini Atoll (Marshall Islands) June 29.

Two other McGraw-Hill editors will see the test but not cover it. Sid Kirkpatrick, editor of *Chemical & Metallurgical Engineering*, goes as one of the civilian technical observers. Donald Fink, executive editor of *Electronics*, is

Monarch Fuse SPRING CLIPS



FERRULE TYPE

KNIFE
BLADE
TYPE

*Prevent
Fuse Failures
Due to
Terminal
Heating*

*Tighten
Fuse Contacts*

Monarch DOUBLE END WRENCH



Users of Monarch Renewable Fuses are provided with this ingenious wrench . . . designed to fit nuts on any and all sizes of our fuses.

MONARCH FUSES Are
Available Through RECOGNIZED
WHOLESALEERS

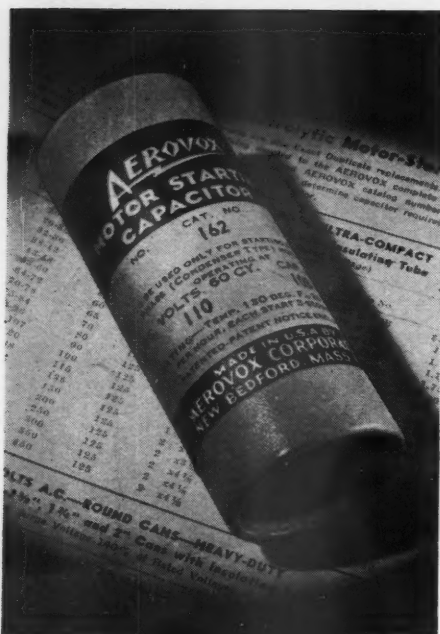
*Specify Monarch Fuses
for improved*

FUSEvice



MONARCH FUSE CO., LTD.
118 E. FIRST ST., JAMESTOWN,

N. Y.



● Yes, it's mighty profitable to service those electric refrigerator motor-starting capacitors the Aerovox Way. The latest Aerovox catalog lists both exact-duplicate and universal types of replacements. Get that replacement at your local Aerovox jobber. Install it for a satisfied customer and a nice profit.

● See Our Jobber . . .

He'll help you select the right replacements for any motor-starting capacitors. He carries a stock for your convenience. Ask him for latest catalog—or write us.



FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

AEROVOX CORP., NEW BEDFORD, MASS., U.S.A.
Export: 13 E. 40th St., New York 16, N.Y. • Cable: 'ARLAB'
In Canada: AEROVOX CANADA LTD., Hamilton, Ont.

a member of the Navy party aboard the electronics control ship.

"Joint Army-Navy Task Force One," headed by Vice Admiral W. P. H. Blandy, is directing this "Operation Crossroads," which will involve the services of 35,000 men, mostly in uniform. These 100-odd target ships, only three or four of which are expected to sink, will be grouped in a carefully planned pattern at the west end of the huge Bikini Atoll (approximately 25 miles by 15 miles).

Two bombs are to be exploded this year. Early in July Bomb No. 1 will be dropped from a high plane to explode in the air. Bomb No. 2 will be set off at or near the water surface late in July or early in August.

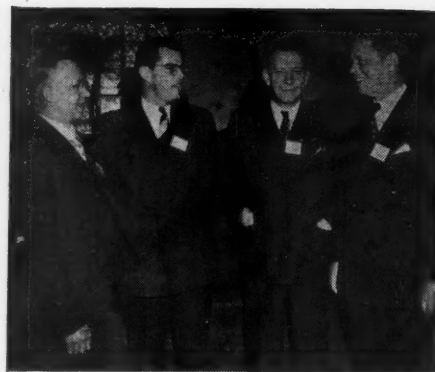
Mr. Swain's report will be written specifically for engineers, industrialists and business men. His own background for this assignment includes degrees in mechanical engineering, experience as a machinist, artillery officer and construction engineer, and extensive early studies in mathematics and physics. He has been active on the McGraw-Hill Atomic Energy Committee since its formation in August, 1945.

LIGHTING CONFERENCE IN SALT LAKE CITY

A concentrated one-day review course on illumination was presented by the Intermountain Electrical Association in conjunction with the Utah Chapter meeting of electrical inspectors. A. E.



C. A. Conklin, Chairman, Pittsburgh Section IES, (l.) led discussion on the Lighting Service Forum at the IES East Central Regional Conference, held in Philadelphia, Pa. Others on this program were (l. to r.): C. C. Shotwell, Philadelphia Electric Company; C. J. Berry, Consolidated Gas Electric Light and Power Company of Baltimore; and J. S. Schuchert, Duquesne Light Company, Pittsburgh, Pa.



Officers of the newly organized Rural Electrical Contractors Association are: (L to R) treasurer—S. O. Sorkness, Sorkness Construction Co., Fargo, N. D.; president—W. P. Cagney, Jr., Contracting and Material Co., Evanston, Ill.; vice-president—R. N. Campsey, R. N. Campsey Construction Co., Denver, Colo.; secretary—P. C. Wallace, Walco Engineering & Construction Co., Tulsa, Oklahoma. RECA was organized Feb. 18, 1946 at Chicago.

Fleming, General Electric Supply Co., was chairman of the lighting conference committee which had on it P. A. Maughan, Charles Wardrop, Raymond Ackerman, Ernest L. Dee, L. G. Gawan, D. H. Hutchinson, Elmer Jonsson, and Homer Shaw.

Ernest Dee, General Electric Lamp Div., presented the history of light, in which the incandescent lamp and its uses were outlined. Elmer Jonsson, Westinghouse Lamp Div., talked on fluorescent and other discharge lamps.

Lester B. Johnson, General Electric Co., then discussed operation and service problems in connection with fluorescent lighting.

Leonard Slusser, associate and partner with Raymond Ackerman, consulting engineer, talked on the importance of lighting maintenance and gave suggested maintenance schedules and practices. A. E. Fleming, General Electric Supply Corp., spoke of general luminaire design, with particular reference to necessity for adequate design of fluorescent lighting units.

J. H. Shaw, Utah Power & Light Co., told of the service companies' general service, single meter rate and its application to lighting.

J. C. Littlefield, Utah Power & Light Co., making use of the Westinghouse training program films, discussed the fundamentals of illumination and general lighting design. Then followed a series of test cases developed before the very eyes of the audience by different people. Dan H. Hutchinson, Graybar Electric Co., took a specific store lighting program and, making use of data from manufacturers information sheets, laid it out in order to achieve the 1-3-5-10 range of lighting intensities recommended for store lighting.

J. Vernon Sharp, electrical contractor, Salt Lake City, did likewise for a

specific office lighting problem; V. J. Vacher, General Electric Supply Corp., for a schoolroom, and P. A. Maughan, Westinghouse Electric Supply Co., for an industrial area.

A. LeRoy Taylor, Dean, School of Mines & Engineering, University of Utah, gave a valuable survey of the question as to whether fluorescent lighting has any deleterious effect on eyesight. His conclusions were that medical research had failed to find any such results.

J. F. McAllister, residential manager, Utah Power & Light Co., presented an illustrated talk on residential lighting and its possibilities, and V. C. Halliday of the same company, its training supervisor, ended the meeting with a presentation of the importance of selling a good lighting job. He made use of the Edison Electric Institute-National Electrical Wholesalers Assn. training films for this subject.

The lighting conference drew an attendance of well over 150 from Salt Lake City, Ogden, Provo and surrounding towns. It was combined with the inspectors meeting which followed and the industry dinner to conclude the affair.

CPA SURVEYS WIRING DEVICE PRODUCTION

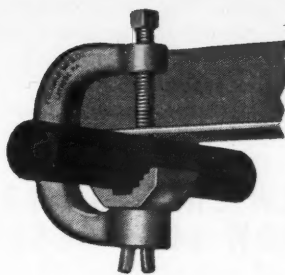
Manufacturers of electrical wiring devices and accessories have been asked to provide Civilian Production Administration with information on production plans, plant capacity and factors limiting production. Producers of such items as toggle switches, convenience outlets, Mogul and medium screw sockets, fluorescent lampholders, wall plates, outlet boxes, EMT couplings and connectors, and other similar items currently



In a huddle at the Square D Company exhibit at recent Milwaukee EME industrial electrical show are: (L to R) Harold Kuehlhorn, asst. chief engineer; Frank Stockinger, maintenance electrician; Henry Westphal, chief engineer—all of Luick Dairy Co. (Milwaukee); and L. E. Wissing, Square D. field engineer who is demonstrating control equipment.

FULLMAN *Latrobe* PRODUCTS

★ FLOOR BOXES ★ WIRING SPECIALTIES



No. 470 "Latrobe" Pipe or Conduit Holder

Quickly installed, convenient and as permanent as need be. Hangs pipe $\frac{1}{2}$ ", $\frac{3}{4}$ " and 1" to steel beams up to $\frac{3}{8}$ ".



No. 284 Nozzle with No. 200 Cover Plate

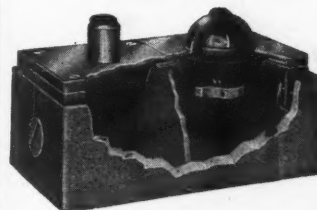
Compact and very practical. Has Duplex Receptacle Nozzle with $\frac{1}{2}$ " or $\frac{3}{4}$ " Brass Pipe extension.

Latrobe Products are quality products. Made of high grade materials, long lasting, dependable. Latrobe Products are economical, being quickly installed they save time, labor and money. Check your stock today.



No. 110 "Latrobe" Watertight Box

Has strong iron box body with $\frac{3}{4}$ " round brass cover plate. Shown with No. 208 receptacle and No. 207 bell nozzle.



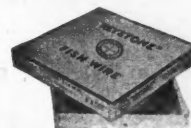
No. 252-R Floor Box

A two-gang Box shown with No. 208 Receptacle in one section. One cover plate has $\frac{1}{2}$ ", the other 2" flush brass plug.



Bull Dog Insulator Support

One of the little things that does a big job, thoroughly and economically. For fastening porcelain or glass insulators to exposed steel framework.

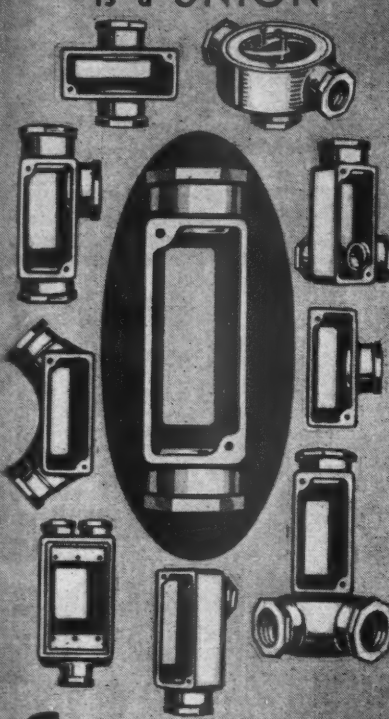


Keystone Fish Wire

Flat steel wire of high quality and properly tempered. May be had in ten sizes.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

**Every Kondu Fitting
is a UNION**



**Every one takes any
kind of Conduit**

Only with Kondu can you take one fitting out of the line and put in another, without disturbing conduit . . . only with Kondu can you put up a conduit line before the fittings are delivered . . . because every Kondu Fitting is a union.

Only with Kondu can you use either standard conduit or thin-wall tubing, at any outlet of any fitting. Just slip out one bushing and slip in another . . . no extra pieces are needed.

Kondu fittings hold permanently tight . . . are vibration-proof. Practically unbreakable . . . 100% re-usable. Self-aligning. Roomy enough for all splices. Write for the Kondu Catalog.

KONDU CORPORATION
Erie, Pa.

KONDU MFG. CO. LTD., Preston, Ontario

KONDU



The Threadless Fitting Line
of Unequalled Variety



indicated to be in short supply, are required to fill out and file Form CPA-4432 with the Electrical Products Section, Building Materials Division, Civilian Production Administration, Washington, 25, D. C., not later than May 31, 1946.

Recent spot checks of the Electrical Wiring Devices and Accessories Industry indicated the probability of a critical shortage of those wiring devices and accessories commonly used in electrical wiring installations in housing and other types of construction, CPA officials said. The questionnaire was prepared to obtain necessary background information to determine whether official governmental action should be taken and, if so, to what extent, it was reported.

NEW ENGLAND TRADE SHOW SETS RECORDS

The Eighth annual Trade Show of the Electrical Manufacturers Representatives Club of New England, staged in the Exhibition Hall of Boston's Mechanics Building during the three-day span from May 15th to 17th, set all-time records for attendance, number of exhibitors and variety of products displayed. Nearly 200 sponsors, presenting the electrical products and accessories of over 400 manufacturers, welcomed the great number of contractors,



B. Eichwald, Senior and Junior; electrical contractors responsible for the lighting, power and audio wiring of the United Nations Security Council interim headquarters at Hunter College, New York City; flank Alex Sitkin; electrical engineer representing Voorhees, Walker, Foley and Smith who designed the architectural plan of the council chamber; in discussing the installation of microphones at the members' curved table.



Contractors and REA engineer have pre-session confab at recent Chicago meeting of the Rural Electrical Contractors Association. They are (L to R) H. L. Cater, Cater Electrical Construction Co., Kansas City, Mo.; R. E. Kattigan, R. E. Mattison & Co., Britton, Okla.; H. T. Nack, White City Electric Co., Chicago; and J. K. O'Shaughnessy, Chief, Design and Construction Division, REA, Washington, D. C.

jobbers, architects, builders, plant executives and utility men who comprehensively represented the potential electrical buying power of the New England states. Specifically planned for the education and demands of the trade, the exhibits presented many wartime developments and discoveries; tangibly demonstrating the possibilities of the immediate future in the fields of lighting, wiring, protective equipment and controls, measuring devices and electronics.

Charles White, show chairman, was assisted by a committee including C. C. Walker, New England district manager, General Electric lamp department; J. V. Leary, Electrical Agencies, Inc., treasurer; R. H. Spalding, Westinghouse lamp department, secretary; Wallace A. Card, New England district manager, National Electric Products Corp., president of the club; Edward F. Galvin, Simplex Wire and Cable Co., club vice president; Charles A. Stone, publisher, *New England Electrical News*, publicity chairman. The general committee included J. H. Ward, R. J. Sullivan, E. F. Galvin, W. H. Etzell, S. J. King, J. J. Slater, H. A. Barnes, A. C. Nelson, C. H. Emerson, C. M. Hall, F. C. Arsenault, S. Resnick and S. A. Imhoff. The show was officially opened by Governor Tobin of Massachusetts.

BOSTON LIGHTING SCHOOL

An eight-session elementary and refresher course on the "Fundamentals of Illumination", jointly sponsored by the Educational Committee of the IES and the Lighting Committee of the Electric Institute of Boston, was presented as a

Electrical Contracting, June 1946

free service to the members of these two organizations during April and May. Presented to an enthusiastic enrollment which doubled pre-session expectations, the course combined theory, application and design of lighting sources and planned layouts for commercial and industrial locations, public buildings, offices and schools. Sound films and slides, charts, diagrams and practical demonstrations aided the presentations by R. B. Brown, Jr., chairman for the Institute; R. R. Wylie, chairman for the IES; H. Reinhardt; R. G. Slauer; C. M. Snyder; K. A. Sawin and P. N. Clerke. The speakers represented the Boston Edison Co., Sylvania Elec. Prod. Co., General Electric Co., Westinghouse Elec. Corp. and Wheeler Reflector Co.

STEVENSON HEADS INDUSTRY COMMITTEE

At a recent meeting of the Industry Committee on Interior Wiring Design, H. R. Stevenson of the Detroit Edison Company was elected Chairman, taking the place of E. A. Brand of the Buffalo Niagara Power Corporation. Mr. Stevenson was also named Chairman of the Technical Subcommittee, which position had been filled heretofore by A. Carl Bredahl of the Westinghouse Electric Corporation.

Under the leadership of Messrs. Brand and Bredahl, the revised "Handbook on Residential Wiring Design" and the newly developed "Farmstead Wiring Handbook" have been brought to completion. Their resignations were prompted because of additional company burdens placed upon them.

A most encouraging report was made on the distribution of the "Handbook of Residential Wiring Design". Since



Returned veterans comprise the major part of the Osborne Electric Company staff at Oklahoma City. Checking a wiring project above are: (L to R) Floyd F. Smith, sales manager; estimator Glen I. Murphy and superintendent John T. McCharen. Owner Marvin R. Osborne is a member of the NECA Board of Governors.

SORGEI AIR-COOLED TRANSFORMERS

Have Everything

Liberal Design

For continuous hard service.

Interchangeable single phase units.

460 or 230 volt primary.

230 or 115 volt 2-wire or 3-wire secondary.

Wall or Floor Mounting

No extra brackets.

Connection Compartment

No junction boxes or extra fittings.

Solderless Terminals

No splicing—No soldering—No taping.

Three-Phase Units

All self-contained.

No complicated connections.

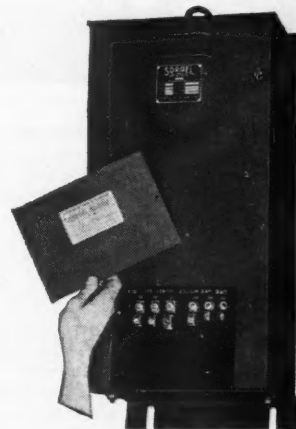
Sizes and Types

For every purpose.

Single phase, poly-phase,
phase changing.

Insulating, Auto, Booster.

¼ to 1000 KVA. All voltages.



3-Phase Wall Mounting Type. Showing Connection Compartment with Solderless Terminals.

SORGEI ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Air-Cooled Transformers



Sav-U-time

"TOUCH BUTTON" Control for GAS WATER HEATERS

THE PRODUCT: Sav-U-time provides push button control for side arm gas water heaters, from bathroom, kitchen or laundry.

THE ADVANTAGES: Hot water at the touch of a button. No stair climbing, no match lighting. Heater only in use when hot water is needed. All the conveniences of automatic hot water heat with gas savings up to 50%.



THE MARKET: Two out of every three homes in your community have side arm gas water heaters. Here is a practically untouched market—all eager for the simple, inexpensive, Sav-U-time.

Sav-U-Time

RETAILS FOR

\$39.50
Plus Installation

THE PRICE: You sell Sav-U-time for \$39.50 plus a small installation charge—with 100% profit for you. It's a price that every home can afford.

IMMEDIATE DELIVERY: Here is a wanted item that you sell, deliver, and collect your profit now.

DEALERSHIPS AVAILABLE: Cut yourself in on this profitable business. Take a tip from dealers in St. Louis, Detroit, Philadelphia—who are cleaning up with Sav-U-time. Many territories still open. National advertising, dealer helps back you up. Write or wire for details **NOW**.

SAV-U-TIME SALES COMPANY

72 Manhattan St., Rochester 2, N. Y.

its release in February, orders for about 185,000 copies have been received. Paper has been ordered for a third printing.

The "Handbook of Farmstead Wiring Design" is now ready for distribution. This book promises to be as popular as the residential handbook, in that orders totaling 50,000 copies have already been received.

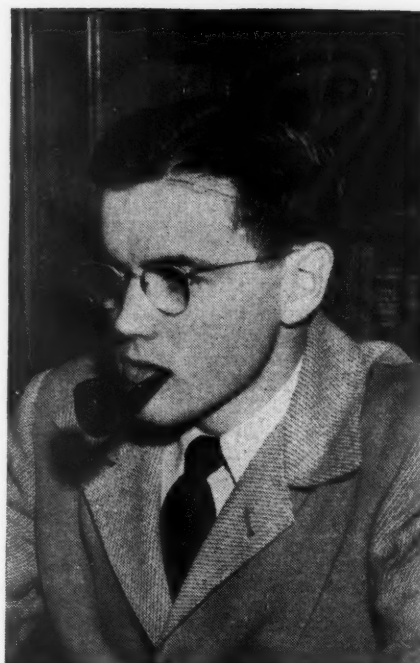
The Technical Subcommittee will commence work on revising the wiring standards for commercial, public and industrial occupancies. This work had been delayed pending the completion of the residential and farmstead wiring standards.

The Committee re-elected A. Carl Bredahl as Secretary.

CONTRACTORS IN TWIN CITY ELECT OFFICERS

Amid record breaking attendances at the annual meetings of the Minneapolis and St. Paul Electrical Contractors Associations in January, the following officers were elected for the 1946 term:

Minneapolis Electrical Contractors Association—W. Arthur Starbird, president; Art Ingebredtsen, vice-president; L. C. White, secretary-treasurer. Elected to the Board of Directors were John Morris, Al Strohmeier, John Kvalsten, O. H. Batzli, Frank T. Langford and William Collins. Chosen to represent the group on the Minnesota Electrical Council Board were W. A. Starbird, John Morris and F. M. Tripp. St. Paul Electrical Contractors Asso-



Young, energetic, Frank F. Sanford is manager of Capitol Electric Co., Oklahoma City electrical contractors. After doing considerable war plant and airport work (as Sanford Construction Co.—now separate), he is ready to tackle REA, industrial and commercial work.

ciation—Lawrence Rylander, president; Ed Hoffman, vice-president; August E. Hansen, secretary-treasurer. Directors elected were: C. A. Yares, Wm. F. Lindberg, Harry Frye, D. F. Kehne, Art Swanson and Paul Schorr, Sr. Representing the group on the Minnesota Electrical Council Board are Lawrence Rylander, D. F. Kehne and Wm. F. Lindberg.

Because of the increase in membership, both associations increased their local directors by two to provide greater representation on the governing boards.

BOOK REVIEWS— INDUSTRIAL ELECTRIC WIRING

A comprehensive treatise on "Industrial Electric Wiring" by E. S. Lincoln, Fellow of the AIEE, presents, in cross-referenced convenient form, all pertinent information on the titled subject. Fundamental facts, tables, diagrams and extensive passages from the National Electrical Code referring to the design, economy, layout, operation and maintenance of all types of wiring make this a concise, plainly-indexed book. The presentation is a re-edited condensation of sections covering fundamentals, wiring systems, inspection and maintenance of industrial machinery and equipment, previously contained in the complete Industrial-Commercial Electrical Reference by the same author. The outstanding advantages of the present book are its handy compactness of size, 5½ by 8½ inches, and its combination in a single medium of information which



Analyzing safety features of new electrical equipment are Clevelanders (L to R) D. J. Bowden, Lamp Dept., General Electric Co.; O. E. Radtke, chief city electrical inspector; and W. W. Adams, manager, apparatus division, Westinghouse Electric Supply Company.

was segregated formerly among numerous sources. Over 100 illustrations describe and analyze the various phases of construction, selection of material and equipment, application, control, inspection, testing, survey and operation costs of all systems for both a-c and d-c wiring. All fittings and devices required for typical jobs are listed, illustrated and discussed.

The text covers 336 pages. Price \$3.00. Essential Books, 270 Madison Ave., New York City 16, N. Y.

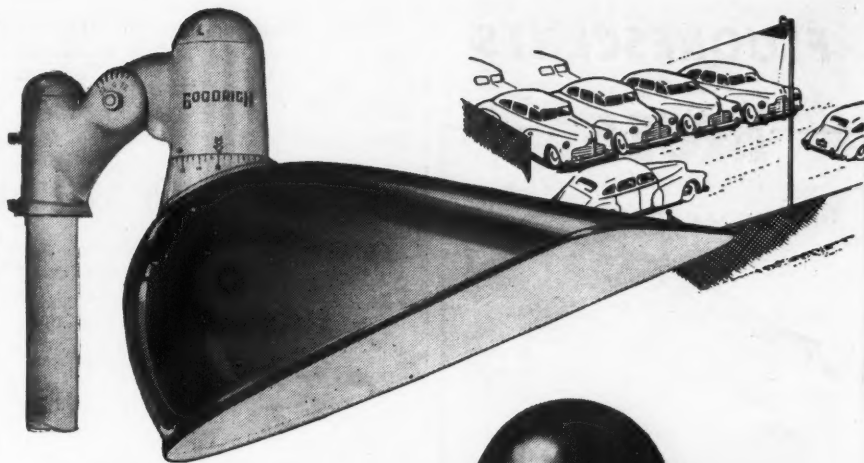
PRIMARY AND STORAGE BATTERIES

A profusely illustrated, 168 page book titled "Primary and Storage Batteries", by E. S. Lincoln, is the sixth volume to be added to the Modern Electrical Series. In a condensed yet complete treatment of the subject, instructions are presented for the selection, application, advantages and maintenance of both primary and secondary or storage batteries. Dry and wet cell, caustic soda and copper oxide primary batteries are included as well as the lead acid and nickle iron alkaline types of secondary batteries. Historical background, characteristics and assembly are discussed in detail and standard specifications, uses and testing procedures are outlined. In addition, modern methods for charging generators, rectifiers and control equipment receive the attention of the author. Tables, diagrams and pictures clearly illustrate the text.

A complete cross referenced index is of



Frank Moos, lamp and lighting specialist, Graybar Electric Company, Philadelphia, Pa., displays what he termed the most important tools in lighting maintenance before the East Central Regional Conference of the Illuminating Engineering Society, Philadelphia, Pa.



Diffuse Floodlight



No. 77
Standlite

INSIDE STORY on outdoor lighting . . .

Perhaps you've wondered why these Goodrich reflectors are seen in tens of thousands of locations. The answer is easy—when you know the facts. Their original designs and high efficiencies have set the standards for modern high intensity illumination.

But the preference of experienced users is based on more than design alone. Sturdy construction is important—so are the cast aluminum mountings which protect against corrosion. Permanent porcelain enamel finish defies all kinds of weather—retains its high factor of reflection through the years. Easier installation, easier wiring, easier servicing are all a part of it. For these are important when you invest in lighting equipment.

Whatever your specific problem in outdoor illumination—from lighting a small sign to a big league park—Goodrich has the answer in a complete line that includes dozens of sizes and styles of reflectors. Goodrich engineers will gladly recommend those best suited to your needs. Write us.

Sold Through Electrical Wholesalers

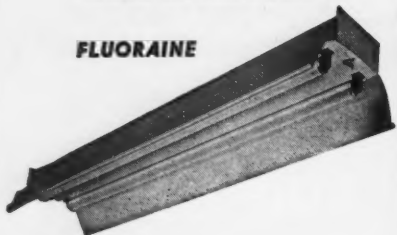


FLUORESCENTS

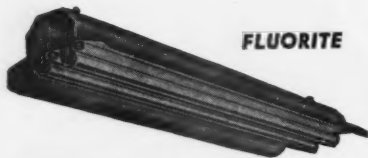
BY

MULTI

FLUORALINE



FLUORITE



GIVE YOU MODERN LIGHTING METHODS

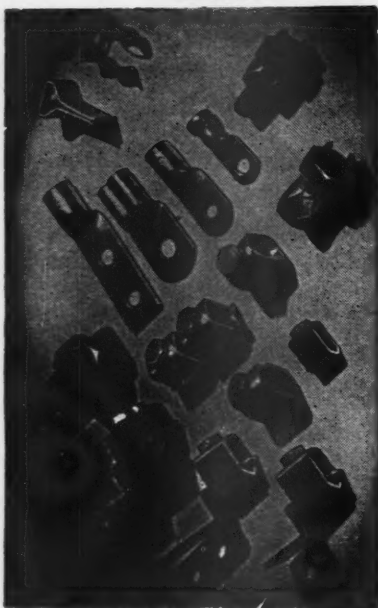
• Give your customers good lighting over long periods . . . modern, practical units that are flexible enough to meet changing demands . . . require little or no maintenance and give you no after worries. Always a good looking finished job with MULTI units. Good lighting is essential to good production—make possible better lighting with MULTI . . . Send for complete catalog.

MULTI

ELECTRICAL MANUFACTURING CO.

4223 W. Lake St., CHICAGO 24, ILL.

ILSCO ELECTRICAL CONNECTORS



100% CONDUCTIVITY

Due to the 99% pure electrolytic copper drawn right in our plant from seamless copper tubes . . . even with overload you'll get 100% satisfaction.

Please send details and 48-page illustrated catalog.

Name

Firm Name

Address

ILSCO

COPPER TUBE
& PRODUCTS, Inc.
CINCINNATI, OHIO

aid when using the book for rapid checking. The book measures 5½ by 8½ inches. Price \$3.00. Essential Books, 270 Madison Ave., New York City 16, N. Y.

ELECTRONS IN ACTION

In his latest book, "Electrons in Action", James Stokley relates the fascinating historic background, development, achievements and possibilities of the research scientist's latest contribution to technical evolution. A very few of man's many inventions deserve the term of epoch-making. This select list; including the lever, wheel, printing press, steam engine and electric motor; now has another outstanding addition—the electron tube. This "next to nothing in a vacuum", employed for speaking, hearing, seeing, smelling, tasting and feeling, can also present its record at any time in any part of the world. The new science of electronics has all the signs of being as extensive and promising as the whole of electricity seemed but a few years ago.

In reading this book, it becomes apparent that the author thoroughly and humanly understands his subject, the events of which he writes and the lives of the men who made these events possible. He tells a vivid story which should be of interest to those seeking a clear, non technical, descriptive account of today's many wonders in the ever-broadening field of electronics.

After answering the initial questions of what electrons are, how they are segregated and put to work, the book extensively discusses the discovery and development of radio, normal and color television, the fluorescent lamp, the use of the radio knife in surgery and numerous electronic applications in industry and warfare. The heating, welding and X-ray of metals and plastics is as absorbingly told as the dramatic review of such war-sponsored inventions as



Visitors at Milwaukee Maintenance Engineers' Industrial Electrical Exposition learn of the strength of the Alnico magnet at the General Electric booth. Device in foreground is an attention directing Thermo-magnetic engine utilizing Curie metal rim which loses magnetism when heated and regains it when cool. Rim passes through magnet whose air gap is heated by a gas flame causing wheel rotation.



Harry Crowder, president of the H. N. Crowder Jr. Company, locates his office in the company's new, modern, reinforced concrete warehouse and shop at Easton, Pennsylvania, while his brother Charles, vice president, keeps an experienced eye on operations in the main Allentown plant. In a reminiscent moment, the brothers recall past experiences in their combined century of service in the electrical field.

radar, loran, buzz bombs, electronic gun directors and the atomic bomb.

The complete index makes the book an excellent reference source and over a hundred pictures, drawings, tables, charts and diagrams augment the 320 pages of text.

James Stokley is well qualified to explain the workings of electronics, having directed the Fels and Buhl Planetariums in Philadelphia and Pittsburgh and having served on the staffs of Science Service, Inc. and the General Electric Research Laboratory.

Whittlesey House, McGraw-Hill Book Co., Inc., 330 West 42nd St., New York City 18, N. Y. Price \$3.00.

DATES AHEAD

Rocky Mt. Chap.—IAEI—City and County Bldg., Denver, Colo., June 11.

Pacific Coast Electrical Association—Annual convention, Fairmont Hotel, San Francisco, Calif., June 12-14.

Illinois Chapter, Western Section, IAEI—Summer meeting, Orlando Hotel, Decatur, Illinois, June 13-14.

National Electrical Manufacturers Association—The Homestead, Hot Springs, Va., June 17-19.

North Dakota Electrical Contractors Association—Summer Conference—Dickenson, North Dakota, June 23-25.

American Society of Agricultural Engineers—Annual Meeting, New Jefferson Hotel, St. Louis, Mo., June 24-26.

American Institute of Technical Engineers—Summer Convention, Detroit, Mich., June 24 to 28.

New York State Association of Electrical Contractors and Dealers, Inc.—Annual convention, Saranac Inn, Saranac, N. Y., July 1-6.

Rocky Mt. Chap.—IAEI—City and County Bldg., Denver, Colo., July 9.

Southern California Construction Industries—Exhibition and Home Show—Pan-Pacific Auditorium, Los Angeles, Cal., July 12-21.

Pacific Coast Convention—AIEE—Seattle, Wash., August 26 to 31.

Rocky Mt. Chap.—IAEI—City and County Bldg., Denver, Col., August 13.

Rocky Mt. Chap.—IAEI—City and County Bldg., Denver, Col., September 10.

Illuminating Engineering Society—National Convention—Chateau Frontenac, Quebec, Canada, September 18-21.

Omaha Electric Show—Sponsored by the Nebraska and Western Iowa Chapter, NECA, Omaha, Nebr., September 23-28.

International Association of Electrical Inspectors—Northwestern Section, location to be announced, Sept. 23-25; Southwestern Section, Hotel Sacramento, Sacramento, Calif., Sept. 30-Oct. 2; Southern Section, Ashville, N. C., Oct. 14-16; Western Section, Gibson Hotel, Cincinnati, Ohio, Oct. 21-23; Eastern Section, location to be announced, Oct. 28-30.

National Electronics Conference—Edgewater Beach Hotel, Chicago, Ill., October 3-5.

National Safety Congress—Hotels Stevens, Congress & Palmer House, Chicago, Ill. Week of October 7.

International Municipal Signal Association, Inc.—Annual Meeting—Miami Colonial Hotel, Miami, Fla., October 14 to 17.

Rocky Mt. Chap.—IAEI—City and County Bldg., Denver, Col., October 8.

National Electrical Manufacturers Association—Annual Meeting—Marlboro-Blenheim and Claridge Hotels, Atlantic City, N. J., October 28 to November 2.

All Industry Refrigeration Show—Public Auditorium, Cleveland, Ohio, October 28-31.

National Electrical Contractors Association—Annual Meeting, Ritz Carlton Hotel, Atlantic City, N. J., Oct. 14-18.

REQUEST FOR INFORMATION

R. N. Thompson, Hubert Davies and Company, Ltd., P. O. Box No. 720, Port Elizabeth, South Africa, has requested information on all types of modern lighting. He would like to have triplicate sets of trade literature pamphlets, reprints, or catalogues. Manufacturers and others having such material available gratis should mail it direct to the above address, or to their shippers, D. C. Andrews and Company, Inc., 27 Water Street, New York, 4, New York, attention Mr. Khouri.

MANUFACTURERS NEWS

G-E APPOINTMENTS

D. F. Roloff, H. K. Pritchard and C. Stonehill have been named to major sales positions in the newly created specialty transformer division of the General Electric Company.


Mr. Roloff, formerly assistant manager sales of the old specialty transformer section, has been appointed assistant manager of the new division. Mr. Pritchard and Mr. Stonehill have been named manager sales, respectively, of the general purpose components section and the lighting components section.

Harold L. Aldrich has been appointed district representative in the New York office of the General Electrical Chemical Department.

The *INTER-MATIC*

TIME SWITCH

is
Well Engineered



DESIGN FEATURE No. 3 FRONT-MOUNTED MOTOR




BECAUSE THE MOTOR IS IN FRONT

—There is never any question whether or not the motor is running. The movement of the rotor can be seen at a glance through the observation window.

—The motor can be replaced without removal of other parts. After the complete mechanism is taken from the case by loosening one screw, the motor is removed by disconnecting the leads and turning out two screws.

WRITE FOR CATALOG
AND NAME OF NEAREST
DISTRIBUTOR

\$9⁰⁰
LIST

F. O. B. CHICAGO
115 V., 60 Cycle

INTERNATIONAL REGISTER CO.
Dept. 66B, 2624 W. Washington Blvd., Chicago 12, Ill.

NEW!

Non-Inductive Conductor Racks



Racks available for any number of cables — cable sizes 5/16" to 2 3/4".

Available in types for any number of cables, the M & W Type S-L Conductor Rack is designed so that cables are only partially surrounded by metal. This prevents induced current—permits the rack to be used for A.C. or D.C. systems. Simple design makes for quick, easy mounting of cables.

Write today for Bulletin C-5-51 . . . contains full information on M. & W. Non-Inductive Cable and Conductor Racks.

M. & W. ELECTRIC MFG. CO.

EAST PALESTINE

OHIO

PROMPT SERVICE FROM

The Jiffy Line

"Jiffy" SNAP-IN BLANKS



"Jiffy" Knockout Seals are safe, cost less and are easy to install. Only one piece, they snap into place. No tools necessary.

"Jiffy" ADJUSTABLE HOLE CUTTER



Cuts clean round holes quickly, easily, and accurately through steel plates, boxes, iron, fibre and other materials. Ratchet wrench and spring pressure make it easy to operate in corners and cramped positions. Also available for use with drill press.

"Jiffy" SOLDER DIPPER



A practical tool for electricians. Lasts a lifetime. It doesn't spill or waste solder, or burn the insulation.

Write for "Jiffy" folder EC for full details.

CLYDE W. LINT CO.

Room 301, 100 So. Jefferson St.
CHICAGO 6, ILLINOIS
The "Jiffy" Line sold thru Jobbers

DON MITCHELL ELECTED PRESIDENT OF SYLVANIA ELECTRIC PRODUCTS

Don G. Mitchell, former executive vice president of Sylvania Electric Products, Inc. was recently elected president of the company by the board of directors. At the same time, Walter E. Poor, who has been president since 1943, was elected chairman of the Board of Directors.

Robert H. Bishop has been named director of sales for all divisions and subsidiaries of Sylvania. He will also



D. G. MITCHELL



R. H. BISHOP



B. K. WICKSTRUM

have direct line responsibility for the sales organization of the lamp, fixture, radio tube and electronics divisions.

B. K. Wickstrum has been appointed general sales manager of lighting products for Sylvania. He will make his headquarters in New York and will be responsible to Mr. Bishop. Since joining Sylvania he has served as West Coast and Mid-West sales manager.

LIGHTING PRODUCTS APPOINTS DAN DUNNE AS SALES MANAGER

Lighting Products Inc., Highland Park, Ill., has announced the appointment of Dan E. Dunne as sales manager. Lt. Dunne has recently been released from the Navy, where he served as ordnance officer in charge of testing anti-air-craft munitions at Boston. Prior to the war, Lt. Dunne represented Chase



DAN DUNNE

Brass & Copper Co. and Edwin F. Guth Co. in the Chicago territory. He was previously lighting specialist for a prominent midwestern wholesaler. He holds a B. S. degree in electrical engineering from Illinois Institute of Technology and has served on various committees of the Chicago Section, Illuminating Engineering Society.

BELDEN APPOINTMENTS

Belden Manufacturing Company, Chicago, has announced that three more men have been graduated from the sales trainee program of the merchandise division and have been assigned territories in line with the sales expansion program of the company. Warren Stuart will represent the company in California; Kerby Garrett will handle all sales in Texas and Oklahoma; and John McEwen will cover New York and New England. The three men have recently been discharged from service.

Harold Hofman, former Kansas City representative, has been transferred to the Pacific Coast and Robert D. Shawl will call on jobbers in Louisiana, Mississippi, Arkansas and Tennessee.

NEW MANAGEMENT FOR ADALET MANUFACTURING CO.

The Adalet Manufacturing Co., Cleveland, Ohio, has been purchased by a group of men who will be active in the management of the company. Henry D. Stecher will be president and general manager; George J. Hales, sales manager and Robert F. Deucher, factory manager. J. C. Boyton, founder of the company, will continue as vice president.

Mr. Stecher was formerly president

Electrical Contracting, June 1946

and general manager of the Romec Pump Co., Elyria and previously was chief engineer of the Weatherhead Co. Mr. Hales was with the General Electric Company and the industrial department of Cleveland Electric Illuminating Co. Mr. Deucher was associated with Mr. Stecher as development engineer at the Weatherhead Co.

ROEBLING APPOINTMENTS

Ferdinand W. Roebling 3rd has been appointed vice president in charge of engineering of John A. Roebling's Sons Company, Trenton, N. J. He succeeds Charles M. Jones, who has become vice president in charge of public and industrial relations. Mr. Roebling recently returned to the company after serving with the U. S. Army Engineers for five years, and retains the rank of Lieutenant Colonel in the Officer Reserve Corps.

The Knoxville, Tenn. office has been

ILG NAMES BRANCH OFFICE MANAGERS

The Ilg Electric Ventilating Co., Chicago, Ill. has named four men as branch office managers.

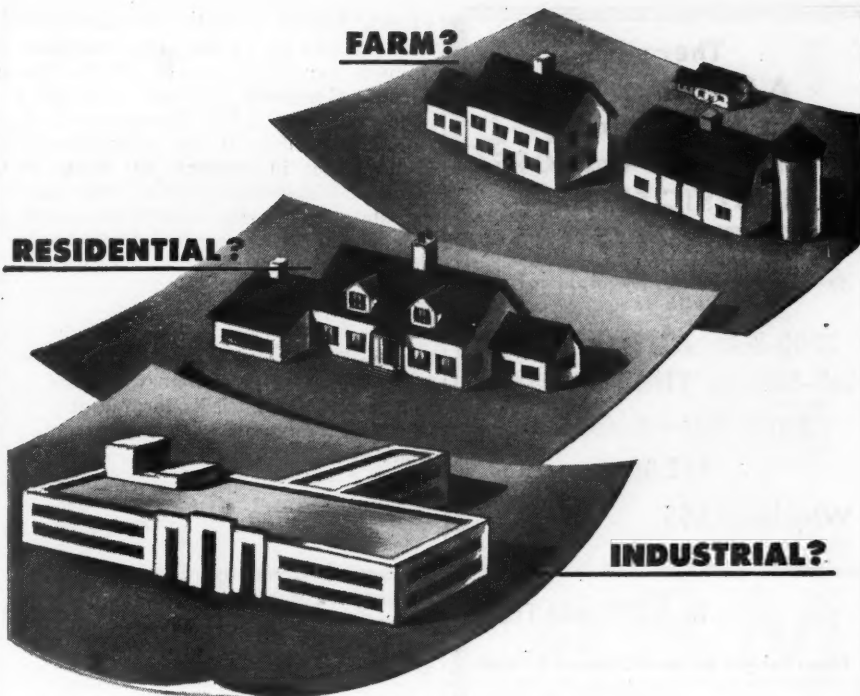
F. H. Bigelow has been appointed manager of the office in Atlanta, Ga. H. H. Wilson, recently released from the Navy, will succeed Mr. Bigelow as manager of the Memphis office. reopened under the supervision of E. Lloyd Widner, Manufacturers representative for the last twelve years.

In Louisville, Ky., Henry M. Lutes has been named as manager.

Sidney C. Palmer has been named manager of the marine and transportation divisions, and Frederick S. Bacon, Jr., manager of the central station division, for the New England district of the Westinghouse Electric Corporation. Their headquarters will be located in Boston.

Feedrail Corporation, New York City, has announced the appointment of Triangle Equipment Co., Inc., St. Louis, as their district representative. They will maintain offices in the Roosevelt Building, 5903 Delmar Blvd., St. Louis and the office will be under the direction of H. L. Boggs and David A. Smith.

Kellogg Switchboard and Supply Company, Chicago, has purchased the assets and business of the Select-O-Phone Company of Providence, R. I., manufacturers of private, commercial and industrial automatic telephone systems.

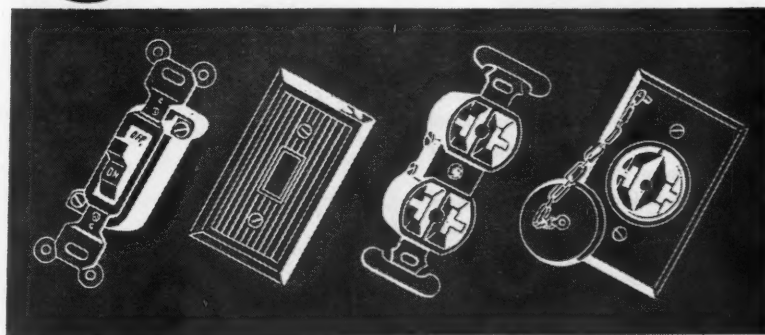
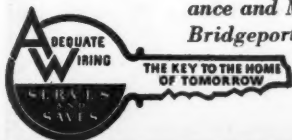


**use G-E wiring devices
to cover all your markets**

WHETHER you specialize in one particular field, or cover them all, you will find that it saves time and trouble to rely on dependable, easy-to-install General Electric wiring devices for all of your jobs. No other name has the prestige and customer acceptance of General Electric.

Perhaps you aren't entirely familiar with the range and variety of G-E wiring devices. They include many sizes and types of switches, outlets, fluorescent starters and accessories, light- and heavy-duty connectors, fuse cutouts, and other components of wiring systems.

Ask your G-E Merchandise Distributor about the G-E wiring device line today, or write Section D661-8, Appliance and Merchandise Department, General Electric Co., Bridgeport, Connecticut.



GENERAL  ELECTRIC

**There Is
A Profit for YOU
In Automatically
Turning ON and OFF
ELECTRIC SIGNS—
LIGHTING SYSTEMS**

And Dozens of Other Applications
with the

**2200-Watt AUTOMATIC
Self-Starting TIME SWITCH**
Single Pole—Model 120
\$12.00

Why buy LESS

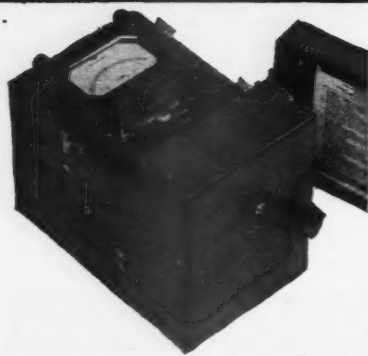
when you get the MOST
in AUTOMATICS

Prices Subject to Usual Discount & Terms

Write for Information

AUTOMATIC
Electric Manufacturing Co.
TIME SWITCHES—FLASHES
MANKATO • MINNESOTA

**New... CRANKLESS
MODEL C-2 MEGOHMER
INSULATION TESTER**



Test Potential to 600 Volts DC. Ranges to 1000 megohms with two or three additional ohm ranges in each instrument. Long mirror scales, hand drawn, individually calibrated, with more scale divisions for superior readability and split hair accuracy. Automatically decreasing test potential protects equipment of low resistance value.

Truly a Precision Instrument
WRITE FOR BULLETIN 445

HERMAN H.

Sticht

COMPANY, INC.
NEW YORK, N. Y.

Florida Electric Supply Company, with headquarters at Tampa, have been appointed representatives of Delta-Star Electric Company, Chicago. The office is in charge of J. A. Meier and J. H. Bragg. An office is also maintained at Jacksonville in charge of Ned H. Morgan. This organization will cover the state of Florida except the north-east portion west of the Apalachicola River.

Cornell-Dubilier Electric Corporation has purchased an eight story building in Worcester, Mass. It is located at 6-22 Grafton Street and known as the Bradley Building.

Holdenline Company, Cleveland, Ohio, has named Gerald Close, 288 Dover Road, Westwood, Mass. as the New England states representative. He was formerly with the Wheeler Reflector Company, Boston.

Winfield Wagener has recently been appointed to the sales engineering staff at Eitel-McCullough, Inc., San Bruno, Calif.

The Standard Transformer Company, Warren, Ohio, has named Walter E. Thompson as sales representative in the state of Alabama. Mr. Thompson will have his offices at 447 Martin Building, Birmingham, Ala.

The Wiremold Company, Hartford, Conn. has named Victor A. Meier as a representative with headquarters at Kansas City, Mo. He will cover Arkansas, Iowa, Kansas, Missouri and Nebraska.

The corporate name of the Warren Telechron Company has been changed to Telechron, Inc., it was announced recently by I. W. Kokins, president. The purpose of the change, he said, was to relate the name Telechron more closely to the company's products.

The Stanley Works, New Britain, Conn. has acquired the business and plant of the North Brothers Mfg. Co. of Philadelphia, Pa., manufacturers of the line of Yankee Tools. The North Brothers Mfg. Co. will continue to operate in Philadelphia with the same equipment and personnel. Management will be under the direction of M. A. Coe, general manager of Stanley Tools.



SODERS

FLUXES

**FOR THOSE TOUGH
SODERING PROBLEMS**



ALLEN has specialized in soldering since 1893 and now has over 130 different flux formulas and many standard formulas to help you give your customers safer, surer jobs. Problems can't come too tough for us to work out. Get complete details.

SODERING SALTS
Convenient powder form. Just add water—3 to 5 parts—according to work.



SODERING STICK

Economical, rapid—just a touch to the hot metal does the work. Non-corrosive—excellent for electrical wiring and cable work.



SODERING PASTE

Adheres to surface being soldered, saves time, triples strength of solder—non-corrosive.

L. B. ALLEN CO. INC.
6715 Bryn Mawr Ave., Chicago 31, Illinois

**HEAVY DUTY
Carbon Lamps**

FOR INDUSTRIAL USE

• Recommended for use where Long Life is essential, where Vibration is excessive, where Inaccessibility of lighting fixtures makes Replacement Difficult, where a Pilot Light is needed.

Available in a wide variety of sizes, shapes, candle power and voltages—standard and candelabra bases.

A large supply of all standard types are carried in stock, thus assuring you prompt service at all times. Write for catalog sheet 1-2 for full details or see your Electrical Wholesaler.



**NORTH AMERICAN
ELECTRIC LAMP CO.**

1044 Tyler Street St. Louis 6, Missouri

WIRING FOR THE PETROLEUM INDUSTRY

[FROM PAGE 62]

Frequently, there is a possibility of using standard electrical equipment as a part of an explosion-proof arrangement. Where such apparatus is housed or installed in a separate room, it can be used if:

a. The equipment room is not a hazardous area.

b. The room is maintained as a non-hazardous area through fresh air circulation and maintenance of a positive pressure within the room to prevent explosive vapors from "backing into" the room.

c. That the proper explosion-proof sealing fittings be installed in all conduit lines running from the non-hazardous area to equipment spotted in hazardous locations.

Cost Justification

The additional cost of explosion-proof equipment is somewhat difficult to justify purely on a cold dollars-and-cents basis. The additional investment must be viewed as an insurance against possible loss of life and property.

Back in 1921-23, before explosion-proof equipment was available, the writer designed refinery installations for another oil company—using standard vapor-proof equipment. To attain maximum safety conditions at that time vapor-proof partitions or walks were installed to separate pump motors from the pumps and controls were located remote from the hazardous areas.

Present day devices and techniques simplify explosion-proof installations and give an added degree of safety. Balanced against the increased equipment costs is the efficiency attained by placing motors and controls in the hazardous areas—eliminating the expense of fire walls and partitions or separate equipment rooms with remote drives and long control circuits.

Where motors are located out of doors, conventional splash-proof or totally enclosed motors would be necessary. Explosion-proof motors, whose cost is not so much greater than the other two types, are also rain-proof and their windings tend to stand up better than splash-proof or open type units.

The potential danger of explosions from electrical causes have been taken into consideration and forestalled by sound judgment of the industry's engineers and by the good management of the industry's executives in approving the additional expenditures.

for... Complete Protection

Specify

UNILARM

the Unit Alarm System ... ready to Install

Unilarm combines in one compact unit the many features essential for complete supervision of all types of electrical and mechanical process control.

Saves valuable space, reduces engineering and installation costs to a minimum.

Plug-in panel cuts maintenance and provides continuous alarm protection.

Test switch gives instant proof of Unilarm's readiness to function under alarm conditions.

Flashing alarm signals every departure from a predetermined normal condition.

Available for panel or surface mounting.

**EXPLOSION-PROOF DUST-TIGHT
VAPORTIGHT GENERAL PURPOSE**



BULLETIN U-46

gives wiring diagrams,
dimensions, prices and
complete information.

Write for your copy
today on your business
stationery.

Since 1902



RUSSELL & STOLL COMPANY, INC.
PRECISION BUILT ELECTRICAL EQUIPMENT
125 BARCLAY STREET • NEW YORK 7, N. Y.

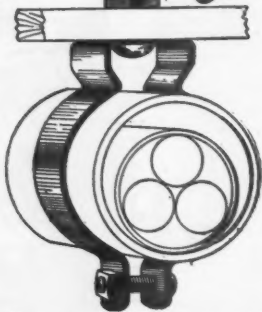
51

179

MINERALLAC

Steel HANGERS, CLIPS, STRAPS

Outserve! Outlast!



Minerallac Cable, Conduit and Messenger Hangers are STEEL. Easier, quicker to install; permit speedy, compact wiring; economical. Also in Everdur... Porcelain Insulating Bushings available.

Jiffy STEEL Clips (Pipe-clamp) require only one screw, nail or bolt; rib-strengthened; for hanging pipe, conduit, BX cable, mounting coils, etc. Millions in use.

Steel Straps for Messenger cable services on outlet boxes; may be used in conjunction with hangers.

Order from your Electrical Wholesaler. Send for literature.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street Chicago 7, Illinois

CUT ANY SIZE
HOLE IN METAL
WOOD PLASTICS

One Bruno Adjustable Hole Cutter replaces many fixed-radius cutters. High speed steel blade cuts clean, fast holes. Fits drill press, portable drill or hand brace. Easily set for any diameter from 5/8" to 1 1/2" or 1" to 2 1/2". Ask your jobber, or write Bruno Tools, Beverly Hills, California, Dept. EC-6.



Model No. 100

\$2.95

Model No.	Shank Size	Cutter Expansion Capacity	User's Price
100	1/4" straight shank	5/8"-1 1/2"	\$2.95
100-B	Square Bit Stock	5/8"-1 1/2"	\$2.95
101	3/8" straight shank	1"-2 1/2"	\$4.95
101-B	Square Bit Stock	1"-2 1/2"	\$4.95

BRUNO TOOLS
Beverly Hills, California

COLOR IN LIGHTING

[FROM PAGE 69]

brown with harvest; yellow with the sun (light and warmth); gold with richness and splendor; green with nature and life; blue with constancy and fidelity; white with light and purity; black with darkness and gloom. Keep these points in mind when recommending finishes in show windows, restaurants, theatres, and the like where mood and atmosphere are important. Color and area are also related—the effect is proportional to the vividness of the color and its area in the visual field. Therefore large-area surfaces in the field of view (such as walls) should be subdued in color, that is, fairly low in saturation.

Color and Store Lighting

Color can make contributions to all of the three major objections of store lighting: attention, appraisal and atmosphere. In store illumination, light of all colors has attention-compelling powers because the general or foundation lighting is always white. Usually colored light is used for creating colored backgrounds in niches and display elements or for modeling. Fluorescent and filament lamps are available in a variety of colors for this purpose. Hard-glass projector spot and flood lamps are particularly useful in modeling with colored light because color roundels can be clipped on such lamps to produce colored highlights and shadows for effective merchandising.

Color of light is an important factor in the purchasing of foods, clothing, home furnishings and a multitude of other items. Accurate appraisal of such merchandise to a large extent depends on the color quality of the lighting system. The need is seen in many stores where buyers must take colored merchandise to the windows or doorways to correctly appraise its color under natural light. Dual color-quality systems or of supplementary counter units can be used to provide appropriate lighting for appraisal.

Proper combinations of color in the store also produce an atmosphere of distinctness and stimulation. Time spent in planning effects which make the store interior unusual and long-remembered will prove profitable to the owner and eventually to the contractor. Among the possibilities are colored lamps in cove and valance elements, decorative luminous ceiling patterns which combine to produce white light for general lighting of various departments to add interest and avoid monotony.

With the sources available today,

there seems no end to the possibilities of using color in store lighting. Some of the other logical applications are in recessed or paneled product signs, colored lamp treatments inside glass-block store and department entrances, colored flood-lighting of suburban stores set back from the street, built-in store front color designs, appropriate seasonal displays, plus decorative treatments in bars, cocktail lounges and theatres. The list is limited only by the ingenuity of the merchant and his lighting consultants.

Color in Industrial Lighting

There are three important aspects of color in industrial lighting operations:

- (1) The finishes of walls and machines which help provide a pleasing background of brightness and color for optimum visual efficiency and comfort.
- (2) The finishes of work and danger areas for safety and visual efficiency.
- (3) The provision of appropriate color-quality lighting for inspection tasks involving the evaluation and discrimination of color.

The choice of industrial finishes depends on many psychological and practical viewpoints. Maintenance is a vital consideration in factories. But of greatest importance is the production of optimum visual efficiency and comfort. It has been proved that for best seeing conditions the ratio of the visual-task brightness to the brightness of its surroundings should be unity. For good seeing conditions the brightness of the immediate surroundings should be no less than one third that of the visual task. In practice, ratios of one to ten are often acceptable.

The immediate surroundings may be areas of the workers' machines, adjacent machines, columns or walls depending on the nature of the work and its location in the interior. Therefore the lighting system and the surface finishes should be so correlated that the recommended brightness ratios are obtained. Because heat and warmth are generally associated with work, cool colors are usually best for factories. Dr. Luckiesh has suggested the following representative color scheme.*

Ceilings—near-white, either a mere suggestion of yellowish-green or even a cream.

Structural Beams—medium tint of bluish-green or pea-green to give the feeling of support. If there are many beams, aluminum paint may be satisfactory.

* Color and Colors, by Matthew Luckiesh, D. Van Nostrand Co., Inc., New York.

Upper Walls and Other Large Vertical Areas—Medium tint of bluish-green.

Dado, Lower Columns—Gray-green. Of course, there are many other suitable combinations. But try to avoid colors which go "flat" under the lighting system—a simple trial in a color box as suggested earlier will disclose such troubles. And don't forget the value of color in recognition, such as the marking of traffic aids, pipes, fire exits, safety precautions, etc.

To delineate critical machine parts and danger areas, color is used to promote visibility and safety. To create contrasts in brightness and color the work or danger area should either be painted a strikingly different color than the rest of the machine or left in its natural finish to produce a condition which instantly focuses attention on the danger point. However, avoid using different colors too profusely or they will lose their effectiveness as contrast media.

Where products must be held to narrow color-tolerance limits, the inspection lighting system should be rich in the spectral region at which the products have maximum absorption (minimum reflectance). This accentuates the difference in color.

For example, small color differences in blue, purple and violet textiles are more easily detected under tungsten-filament lamps than under natural or artificial daylight. Differences in red and pink textiles are more easily seen under natural or artificial daylight; there is little choice for greens and yellows. However, the source should produce light throughout the visible spectrum and should be so located that specular reflections are avoided.

The ceilings of offices should be finished with white paint having a reflection factor of 80-85 percent. The walls can be finished in hues which compliment the exposure; for example, warm colors for rooms with northern exposure and cool colors otherwise. Reflection factors of walls should be 50-60 percent. The dado or lower wall should have a reflection factor of 30-40 percent. Desk tops need a lighter finish than the 5-7 percent prevalent today; 40-50 percent is recommended with 35 percent the minimum. The desk sides can be even higher in reflectance because the vertical illumination is almost always less than the horizontal.

The contractor who uses light as an effective color medium will find it the door to expanded business. Why not make light and color a part of your business? Painting with light and lighting with paint logically should be combined for most effective results.

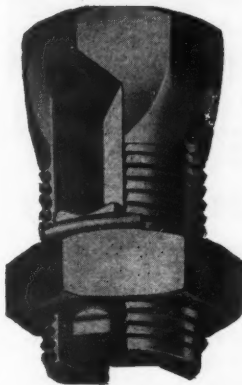
Frankel

BUGS

BUG is the Frankel trade name for their split-bolt connector.

Because of the range of cable sizes and combination of cables each size takes, the utility of split-bolt connectors is widely recognized.

Frankel **BUGS**, made with bronze bodies—forged bronze spacers, and duronze nuts are guaranteed against season cracking.



BUGS come in two types; the **SERVICE BUG** (illustrated), and the **POLE LINE BUG**, which has a retaining chain, that keeps the nut and spacer from being separated from the body. The **POLE LINE BUG** is usually required by the utilities. Literature upon request.

FRANKEL CONNECTOR CO.

27 VESTRY STREET • NEW YORK 13, N. Y.

WOW! THAT GRIP IS THE NEAREST THING YET TO GOLD SEAL TAPE!



Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM and Federal specifications.



Most electricians know that Gold Seal sticks tighter anywhere because there's more lasting tackiness in the friction compound—more tensile strength in the fabric. Gold Seal Tape won't dry out or smear in any weather—won't ravel or peel. It's laboratory-tested at every step, and it comes to you factory-fresh, cellophane wrapped and boxed. If you don't already use Gold Seal Tape—try a roll! Jenkins Bros., Rubber Division, 80 White Street, New York 13.

Gold Seal Tape

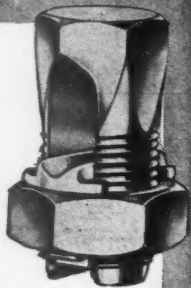
FRICTION and RUBBER TAPES

JENKINS

MADE BY JENKINS BROS . . . MAKERS OF FAMOUS JENKINS VALVES

Conductor Fittings

Service Connectors of all sizes and types—Yoke - and - Nut Type from No. 10 to 1,000,000. Also Service Entrance Connectors, Service Post and special connectors.



Penn-Union also makes a complete line of Tee Connectors; Cable Taps; Straight, Parallel, Elbow and Cross Connectors; Bus Supports; Grounding Clamps, Lugs, etc. etc. Leading users have found that "Penn-Union" on a fitting is their best guarantee of Dependability.

PENN-UNION ELECTRIC CORP.
ERIE, PA.

PENN-UNION



Since
1898

It's GARC Y for better lighting

Check the outstanding lighting installations of the country in stores, offices, hospitals, banks, factories—even subways—and you will come across GARC Y lighting with amazing frequency. Specialized reflectors, strip lighting, troffers, ceiling fixtures, every GARC Y item carefully designed and thoroughly engineered for maximum beauty, efficiency, utility. Catalogs available.

GARDEN CITY PLATING & MFG. CO., INC.
OGDEN BLVD. & S. TALMAN AVE.
CHICAGO 8, ILL.

Save time and effort in winding and connecting jobs

Diagrams and connecting tables for laying out coils and connecting them in proper sequence for motors of from 2 to 24 poles, 2- and 3-phase

This practical manual saves your studying out connections before you begin work, and saves drawing up a new diagram every time you do a winding job by supplying the diagrams and connecting tables for all the different kinds of windings used in motors from 2- to 24-poles, two- and three-phase. It furnishes practical, step-by-step instruction on the laying out of coils for induction-motor windings and connecting the ends of the groups of these coils in proper sequence of phase and pole groups.



Just published!

REPAIR SHOP DIAGRAMS AND CONNECTING TABLES FOR LAP-WOUND INDUCTION MOTORS

By DANIEL H. BRAYMER, Late Editorial Director, Industrial Engineer and A. C. ROE, Manufacturing Engineer, Manufacturing and Repair Department, Westinghouse Electric Corporation

Each one of the many scores of diagrams in this manual is a practical shop drawing, marked with proper connections for the ends of all phase groups of coils so that they can be actually followed by the winder when making connections.

The diagrams are accompanied by tables that give the number of coils in the different phase groups and the markings for the ends of these groups as indicated on the diagrams, to show the difference in markings for the ends of phase groups in different types of windings.

This new, revised edition of this popular shop manual incorporates the many changes and advances in the design and construction of induction motors through World War II. The information given here may also be used when reconnecting the coil groups to satisfy changes in voltage, changes for operation on circuits of different number of phases, different frequencies or changes in the speed of a motor.

Second Edition, 387 pages, 182 figures.

52 tables, 74 Charts, \$3.50

See it 10 days FREE Mail Coupon

McGRAW-HILL BOOK CO., 330 W. 42 St.,

N. Y. C. 18

Send me Braymer and Roe's REPAIR SHOP DIAGRAMS for 10 days examination on approval. In 10 days I will send \$3.50, plus few cents postage, or return book postpaid. (Postage paid on cash orders.)

Name

Address

City and State

Company

Position

(For Canadian prices write Embassy Book Co., 12 Richmond St. E., Toronto 1.)

REWINDING AND RECONNECTING A-C MOTORS

[FROM PAGE 76]

winding is found by the d-c method and three times that amount is added to the starting winding. A similar connection is shown in Fig. 3.

Two-phase to three-phase change.—For several justifiable reasons, three-phase motors are usually connected in series star. So connected, a three-phase motor has 20 percent less turns in its windings than the corresponding two-phase motor. If the three-phase motor is delta connected, it will have about 38 percent more turns in series than are actually necessary for two-phase operation.

The full load current of a three-phase motor is $2/1.73$ or 115 percent of the current in a two-phase motor. The output of the three-phase motor is thus limited to 87 percent of its two-phase rating. In certain cases, it may be more advantageous to rewind the motor with the proper number of turns of suitable size wire rather than resort to reconnection at the sacrifice of output and excellence of performance.

There are several methods of reconnection from two to three-phase, but of these, the most satisfactory method is the cutting out of 20 percent of the two-phase coils symmetrically and reconnecting the resulting winding in series star.

Example.—Assume a two-phase, 6 pole motor with 72 coils grouped into 2 phase x 6 poles = 12 pole-phase groups connected six and six in series across 220 volts, two-phase. It is required to reconnect this motor for operation on a three-phase, 220 volt supply.

There are 72 coils / 12 pole-phase groups = 6 coils in each group. This winding reconnected 6-pole for operation on three-phase, will need only 72 coils x 0.80 = 57.6 coils. On three-phase, there will be 3 phases x 6 poles = 18 pole-phase groups. As each group will have the same number of coils, there will be a total of 3 phases x 18 pole-phase groups = 54 coils instead of the calculated 57.6 coils. The number of two-phase coils to be left dead will then be $72 - 54 = 18$ coils or 1 coil dead in each group. This arrangement is shown in Fig. 4. Due to the resulting higher voltage per coil (54 coils instead of 57.6 coils), the starting and maximum torques will be increased in the proportion of $(57.6 / 54)^2 = 14$ percent. The resulting overvoltage of $57.6 / 54 = 7$ percent is permissible and compensates for part of the 13 percent loss in horsepower rating after reconnection of the motor windings.

WHAT IS THE MARKUP?

[FROM PAGE 72]

of labor cost are engineering, supervision and tools. A large portion of the engineer's time, and all of the draftsman's time, are used in the preparation of plans for the installation. We call the product "working drawings" because they are to facilitate labor. There is no alternative for charging the expense of field engineering, supervision and tools. Division of other items of expense can be substantiated.

Overhead Division

In establishing the division of overhead, the job costs were used only as a check. For the overall costs of the annual volume, the two ratios $\frac{\text{material}}{\text{labor}}$ are pretty much in the same proportion (neglecting insurances on labor). The ratios are:

For Job Costs:

$$\frac{\text{Material}}{\text{Labor}} = \frac{4.43}{14.11^*} = 0.315$$

$$*14.11 = 28.11 - 14 \text{ (insurances)}$$

For Overhead:

$$\frac{\text{Material}}{\text{Labor}} = \frac{6.96}{23.89} = 0.292$$

The overhead divisions were influenced by factors other than job cost and no attempt was made to get the two ratios to coincide.

The overhead percentages shown are 6.96, 23.89 and 13.73 for material, labor, and job, respectively. To simplify calculations 7 percent, 24 percent and 13.8 percent can be used. The percentage shown for labor is more than three times as great as that for material, but in dollars the labor cost is approximately twice as great.

For each \$100 base cost the overhead cost would be:

$$\begin{aligned} \text{For Material } \$60 @ 7 \text{ percent} &= \$4.20 \\ \text{For Labor } \$40 @ 24 \text{ percent} &= 9.60 \end{aligned}$$

$$\text{Total } \$13.80$$

The administrative expense was divided fairly well in proportion to the sum of other items. Other cost divisions were based on various studies.

At a glance, it may appear that the division of some expenses put too much weight on labor. For instance we are in the habit of thinking of a stock room man as one who handles materials. In most businesses handling a \$500,000 volume, the man in the stockroom is more or less of a mechanic. As very little of the material goes through the stock room, this mechanic spends most



All you need to hang Chain Suspension Fixtures is a screw driver plus a

HYDEE HANGER*

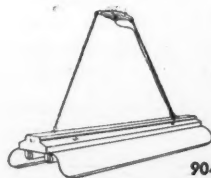
Just connect wires, screw to outlet box and the job's done—in a few minutes!

Self-grounding—2-wire cord and plug may be used. Fits standard 4" or 3 1/4" outlet box or plaster ring. Complete with receptacle, two 5-foot chains, "S" hooks and cord clips. Nothing else to buy. **\$1.50**

Each List

Day-Brite Lighting, Inc., 5401 Bulwer Ave., St. Louis 7, Mo. Nationally distributed through leading electrical supply houses.

*Patent No. D-141024.
Others pending.
Underwriters approved.

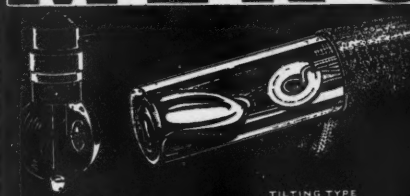


904

IT'S EASY TO SEE WHEN IT'S

DAY-BRITE
Lighting

MERCOID



FOR HEATING, AIR CONDITIONING, REFRIGERATION, AND VARIOUS INDUSTRIAL APPLICATIONS

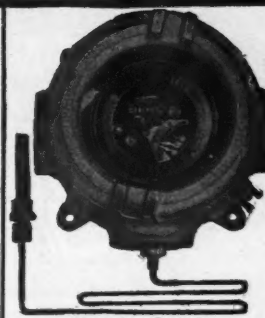
The **Only 100%**
Mercury Switch
Equipped Controls



Pressure Control

Designed to automatically regulate electrically operated equipment in accordance with changes in temperature, pressure, vacuum, fluid level or mechanical movement.

Mercoid Controls have many desirable features which have made them favorites among leading industrial engineers.



Temperature Control in Explosion-proof case

DA (Double Adjustment) Temperature or Pressure Controls are used extensively on industrial applications. The outside double adjustment facilitates the control operating range setting. The calibrated dial plainly indicates the desired setting. All guesswork is eliminated. No cover to open or remove when making control adjustments. A locking device is provided to prevent tampering. Various ranges available. The hermetically sealed mercury switches are dust and corrosion-proof. There is no open arcing, pitting or sticking of contacts. These switches assure better control performance and longer control life.

If you have a pressure or temperature control problem Mercoid engineers will assist you.

See catalog No. 600 for complete information on all types of Mercoid Controls.

THE MERCOID CORPORATION, 4225 BELMONT AVE., CHICAGO 41, ILLINOIS

DIOGENES
It's taken me a long time... but I have found the line that lives up to its claim

Revere LIGHTING EQUIPMENT...

has never let the contractor down! Every Revere Unit can be depended upon to do the job expected of it and is the best that money can buy... plus easy to wire and maintain.

REVERE HINGED POLE

Safe... Service and clean floodlights from the ground. No ladders — no dangerous climbing. 20, 24 and 30-foot mounting heights.

For effective, uniform over-all lighting — concentrate on Revere Elliptor No. 3800 — 300 to 1500 watts. Available in Steel Porcelain enameled or Alzak Aluminum

No. 4200 Powerful floodlight for wide area lighting

Write for catalog data.

REVERE ELECTRIC MFG. CO.
4017 Broadway — Chicago 40, Ill.

GEDNEY
GEDNEY FITTINGS... FIT!
FITTINGS

GEDNEY Fittings and Conduit Bodies are rigidly inspected, cleanly finished and carry the approval of Underwriters Laboratories. They are carefully packed in metal-edge cartons, convenient quantities, clearly labeled. Wholesale distribution only. Write for catalog.

GEDNEY ELECTRIC COMPANY
RKO BLDG. RADIO CITY, NEW YORK, N. Y.

of his time handling and repairing tools and fabricating materials to reduce on-the-job labor.

Again, we have the telephone. More calls are made about material than about labor, but most of those pertaining to material are follow up calls made to time deliveries to fit labor, or to get information for installation purposes. Other expenses, perhaps should be charged to labor. Advertising and promotional expense are two in particular.

Two items shown here (Exhibit "B", Fig. 2) have not appeared in any other overhead listings which have been brought to our attention. Those referred to are "Research and Time Studies" and "Adjustment Factor." Both of these are definite costs, and if the contractor does not pay for them in one way he will in another.

Research and Time Studies

"Research and Time Studies" have an allotment of 0.16 percent which for \$500,000 (base cost) volume would be \$800 per year. For smaller volumes the costs would be reduced approximately in proportion. To illustrate how the costs might be distributed, let us consider a business with a \$100,000 annual volume, and assume that cost studies were made every two years. At 0.16 percent, the expenditure would be \$160 per year.

As this expense occurs every other year, the cost per year would be \$312 divided by two or \$156.00. If anything, these figures are low. Some contractors spend more than this amount per year getting adjusted to new types of work.

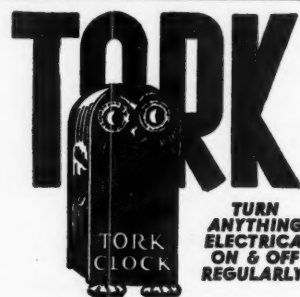
Note: Contractors often rely on a foreman to keep data on field costs. To get best results, a separate account should be set up for him to charge his time against. Few foremen are willing to take a chance on having job costs run too high because time charged against the job belonged to the office account.

A contractor who desires the best results must spend money and time studying all the phases of his business. Too many contractors would like to sit back and have some one else spend his money establishing labor units and operating costs. The contractor who makes no effort to do his own research can little hope to reap any great benefits from data supplied by others.

The National Electrical Contractors' Association, under the direction of Mr. George Patterson, chairman of the cost data committee, prepared a manual of labor units for use of its members. It was one of the best of its kind ever published, and members who regularly conducted labor cost studies, found it to be an excellent contribution to the work they were doing.

WHERE TO BUY

Equipment, Materials and Supplies for Electrical Construction — Maintenance — Repairs



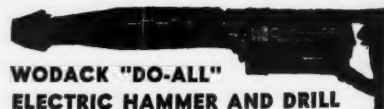
The TORK CLOCK CO., Inc.
MOUNT VERNON, NEW YORK

REPAIR YOUR ELECTRIC APPLIANCES WITH NEW AMAZING NICHROCITE

Burned Out or Broken Electric Heating Elements Repaired Instantly...

Simply overlap ends, apply Nichrocite paste and turn on the current — a perfect weld results. Used by big utility companies and repair shops. Just the thing for that broken or burned out heating element in your electric iron, stove, toaster or heater. Does the job in a jiffy. Trial order, \$1; 4 ozs. \$2.50; 1 lb. \$5.00. Armstrong Electric Co., Box 861 - EC, Minneapolis, Minn.

DRILL CONCRETE THE EASY WAY



WODACK "DO-ALL" ELECTRIC HAMMER AND DRILL

Saves time and labor installing expansion anchors. Two motions—reciprocal for hammer drilling—rotary for twist drilling. Drills masonry to 1 1/2", dia., metal 3/4". Easy to maintain. Universal motor, runs direct from lamp socket. Weighs 15 lbs. Star drills in 17 diameters. Also chisels, built points, etc. Ask for Bulletin 442-EC.

Wodack Electric Tool Corporation
4627 W. Huron St. Chicago 44, Ill.
Telephone AUstin 9886

This WHERE TO BUY Section

supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical operation, maintenance and service. Make a habit of checking this page, each issue.

Classified Advertising Division
ELECTRICAL CONTRACTING

Estimators who have no data of their own, and are not familiar with methods of preparing cost data, cannot intelligently interpret such information supplied by others.

Contractors focus their attention on labor cost studies and overlook the gains to be enjoyed from operating cost research. In a previous article attention was called to the errors committed in estimating after the costs of material and labor have been established. The only way to eliminate such errors, is to have contractors who study operating costs thoroughly enough to be able to appraise each job according to its individual merits.

Adjustment Factor

Anyone with foresight knows that there will be slump periods. He will know also that there should be a reserve to take up the slack at such times. In looking over curves for construction activities, and studying business cycles, we decided that the best a contractor can hope for is to have seven out of every ten years providing good business.

The allowance of 0.75 percent for "Adjustment Factor" represents the absolute minimum. It is so low that it may be a mistake to publish it. If the organization were to be kept intact and only reasonable reductions made in salaries, the "Adjustment Factor" would be more like $2\frac{1}{2}$ to 3 percent. An explanation of how the 0.75 figure was developed will enable the contractor to make his own adjustment.

It was assumed that—by laying off some of the engineering and office help, and reducing salaries of the remaining personnel, coupled with possible concessions in rent and reduction in other operating costs—the overhead could be cut to 60 percent of normal.

The advantages of using this adjustment factor are evident. The normal years (which can stand it) take the greater share of the overhead, relieving the pressure on the lean years.

The above calculations on an assumed business include nothing to compensate for salaries paid men during slump times, just to keep them busy. Neither is there any allowance for operating cost losses on jobs taken with a low markup, just to keep the organization intact.

We do not have to be smart to deduce that any electrical contractor, who is aware of true operating costs, will find it imperative to include a substantial percentage in his costs for holding his business together during slump periods. Neither do we have to be smart to know that the principal reason for holding the organization together is to be ready to supply installation services. Material

PUT CEILING VENTILATION

in every G. I. home

Blo-Fan Ceiling Ventilators cut both cost and frequency of interior cleaning. These efficient modern ventilators literally scoop up cooking smoke and odors as they rise—before they smear walls or furnishings. Blo-Fans combine the principles of both breeze fan and blower. They have power and volume!

Blo-Fans belong in both single and multiple dwelling units—in kitchens, bathrooms, rumpus rooms and laundries. The cost is little.

Buyer or renter, the G. I. family wants a home that's free from cooking-grease walls and tattletale odors... There are Blo-Fan models for all classes of homes, from the smallest to the most pretentious.

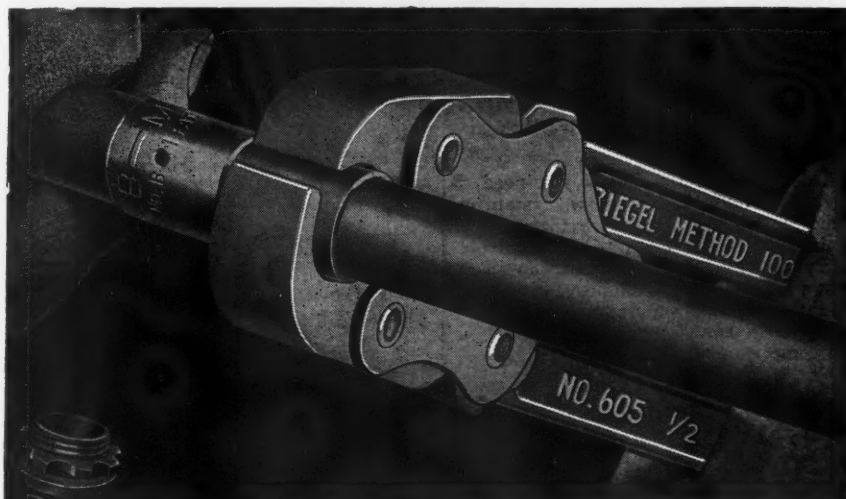
Distributed by

Franchised Wholesalers

Throughout the Country

PRYNE & CO., INC.
LOS ANGELES 54, CALIFORNIA

BRANCHES • NEW YORK • CHICAGO • HOUSTON • SAN FRANCISCO



E-M-T CONNECTIONS IN A FEW SECONDS!

With B. M. Fittings

TWO QUICK SQUEEZES give you Finer, Faster Conduit Connections. B-M Fittings do away with the twisting, turning and tightening of nuts and save you valuable time and materials. Then too, they are stronger, neater and much easier to work with in tight places. Start using B-M Fittings today. Have more satisfied customers—more profits from each job!

(All B-M Fittings carry the Underwriters Seal of Approval)

DISTRIBUTED BY

The M. B. Austin Co., Chicago, Ill.
Clayton Mark & Co., Evanston, Ill.
Clifton Conduit Co., Jersey City, N. J.
Gen. Electric Co., Bridgeport, Conn.
The Steelduct Co., Youngstown, Ohio
Enameled Metals, Pittsburgh, Penn.
National Enameling & Mfg. Co., Pittsburgh, Pa.
Triangle Conduit & Cable Co., New Brunswick, N. J.



BRIEGL METHOD TOOL CO. • Galva, Ill.

INCREASING YOUR HOLD ON YOUR JOB



and giving yourself a chance for advancement

Few men deliberately plan to work persistently on self-improvement. If progress comes naturally, they are happy; if it does not, they either worry or they entirely ignore the situation.

Yet it is possible to pay attention to self-improvement with considerable hope of success. A noticeable degree of advancement is practically assured to anyone who will make an intelligent and persistent effort.

Thousands of men have proved this for themselves, with the use of

The CROFT Library of Practical Electricity

7 Volumes, 2906 pages
1948 how-to-do-it illustrations

● The Croft Library is a complete electrical educator. Founded on practice—on 20 years of shirt-sleeve experience—on work as it is actually done. Jammed from cover to cover with the kind of hardheaded facts you want. Written so that the beginner can easily understand it, yet so sound, so thorough, that it is the daily guide of 59,000 highly paid electrical workers and engineers.

● Croft tells you the things you need to know about motors, generators, armatures, commutators, transformers, circuits, switchboards, distribution systems—electrical machinery of every type—illumination in its every phase—the most improved methods of lighting—lamps and lamp effects, etc.—how to do a complete job, from planning it, to completion.

NO MONEY DOWN EASY PAYMENTS

10 DAYS' FREE EXAMINATION

Fill in and mail the coupon below and we will send you the entire set of seven volumes for ten days examination on approval. We will take all the risk—you assume no obligation. If you decide to keep the books, send \$3.50 in ten days and the balance at the rate of \$4.00 a month.

Send this McGRAW-HILL coupon

McGRAW-HILL BOOK CO.
330 W. 42nd St., New York 18, N. Y.

You may send me the seven volumes of the Croft Library of Practical Electricity for 10 days' examination. I agree to return the books, postpaid, in ten days or remit \$3.50 then and \$4.00 a month until the special price of \$19.50 has been paid.

(To insure prompt shipment, write plainly and fill in all lines.)

Name

Home Address

City and State

Position

Name of Company EC-46

For Canadian prices write Embassy Book Co.,
12 Richmond St. E., Toronto 1.

supply is scarcely given secondary consideration.

In some localities apprentice rates are such that the total cost of training apprentices is a considerable item. No allowance has been made for this factor in these discussions. It is assumed that such cost is offset by the benefits contractors gain when they train apprentices to their own production methods. At least, a contractor or his job superintendent should select apprentices carefully enough and spend sufficient time with them to make the investment pay off in the long run.

Many contractors suggest that if they were paid for worrying, there would be another item of expense chargeable to labor. They are always worrying about something connected with labor; about securing good mechanics, keeping their men, getting the work estimated correctly, holding the labor within the estimate, labor agreements, and numerous other factors related to labor. One hears a lot about such contracting problems, but little or nothing concerning material worries insofar as operating costs are involved.

One may ask, "What does this have to do with operating costs?" It definitely influences the division of costs. Attention is divided according to concern. Attention takes time and time costs money.

It is my personal opinion that if a better line of demarcation could be established, we would find that the overhead percentage allowed for material should be decreased and that for labor increased. I have no monopoly on this opinion; some contractors suggest drastic revisions in the direction suggested above. Others go so far as to suggest that labor carry all the overhead costs.

In the next article of this series, figures will be presented which illustrate, at a glance, how dangerous the practice of using "common markup" can be.



H. T. Nack (left), White City Electric Co., Chicago, shares his REA experiences with Lloyd Jack, Killoren Electric Co., Appleton, Wis., and pole supplier L. L. Roberts of the King Lumber Industry, Canton, Mississippi. Huddle took place at recent RECA meeting in Chicago.

SEARCHLIGHT SECTION

(Classified Advertising)

Employment Business

Equipment

(Used or Resale)

"OPPORTUNITIES"

UNDISPLAYED RATES

15 Cents a Word. Minimum Charge \$3.00. POSITIONS WANTED (full or part time individual salaried employment only), 1/2 the above rates payable in advance.

BOX NUMBERS—Care of publication New York, Chicago or San Francisco offices count as 10 words. DISCOUNT OF 10% if full payment is made in advance for 4 consecutive insertions.

DISPLAYED RATE

INDIVIDUAL SPACES with border rules for prominent display of advertisements. The advertising rate is \$8.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured 1/4" vertically on one column, 3 columns—30 inches—to a page.

NEW ADVERTISEMENTS received by June 25th will appear in the July issue, subject to limitations of space available.

WANTED

WANTED AN Electric joist borer, Fred P. McCarthy, Narberth, Pa.

REPRESENTATION AVAILABLE

For Manufacturers of

Mechanical & Electrical Products

Cornell Graduate Engineer 14 years mechanical and electrical engineering experience in Industrial and Marine Fields, technical sales work and straight engineering, interested in representing manufacturers of quality mechanical and electrical products in the States of Louisiana, Mississippi, Southern Alabama, Arkansas and Eastern Texas on commission basis or direct billing.

Address: ADVERTISER

1514 Broadway New Orleans, 18, La.

FOR SALE

2000-ELECTRIC BULBS

32 Volts. 15-Watts. Frosted. 5¢ Each.
In 100 Lots, Only.

SAMUEL SANCENITO

35 Monroe Street Passaic, New Jersey

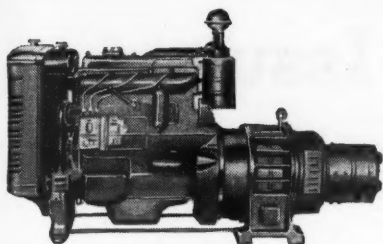
\$ — \$ — \$

MOTORS, GENERATORS, TRANSFORMERS BOUGHT & SOLD

For prompt action, wire specifications collect

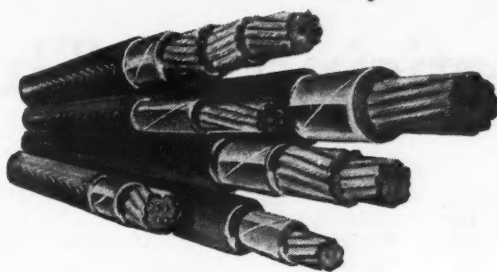
ELECTRIC EQUIPMENT CO.

PHONES: GLENWOOD 6783-6784-6785
63 CURLEW STREET, P. O. BOX 51 • ROCHESTER, N. Y.



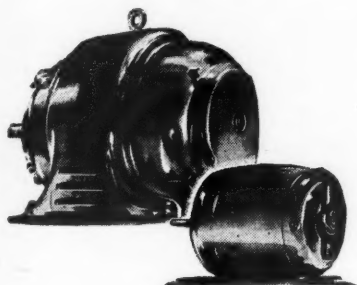
GENERATORS

If unit power generation is your problem, it will pay you to check our large lists of this type of equipment. We have gasoline, steam, Diesel and electric driven generators—and generators without prime movers) in a wide range of load and voltage characteristics, in both a-c and d-c.



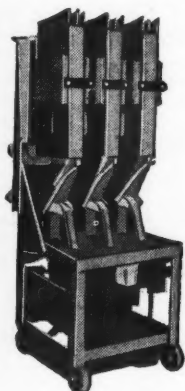
WIRE & CABLE

Our inventory includes an innumerable variety of wire and cable in sizes and insulations usable in industry. Many types conform to underwriters' specifications—others were made for special purposes but are adaptable to industrial and commercial applications.



MOTORS

We have a large supply of electric motors, both a-c and d-c, in unusual speeds, voltages and loads. If you have applications in which these motors can be adapted, inquire at your nearest Regional Office for full particulars and prices.



SWITCH GEAR

Special items in this category are now available if you can use them. Check your requirements and avail yourself of this opportunity to purchase switch gear at considerable savings. Consult your nearest W. A. A. office for description, location and prices.

STANDARD AND SPECIAL ELECTRICAL EQUIPMENT

FOR SALE

priced for immediate disposal

The War Assets Administration offers you government-owned surplus electrical machinery and equipment for your reconversion program at *substantially reduced prices*.

The offer includes wire and cable, generator sets, transformers, switch gear, wiring devices, sub-station power conversion and protective equipment. Much of it is special but adaptable to a large variety of uses.

It has been *priced to sell* and represents attractive bargains to the alert and resourceful industrialist engaging in speedy reconversion.

(Cut out and send to the nearest WAA office listed below)

War Assets Administration: I am interested in the following checked items:

- | | |
|--|---|
| <input type="checkbox"/> WIRE & CABLE | <input type="checkbox"/> WIRING DEVICES |
| <input type="checkbox"/> GENERATORS | <input type="checkbox"/> POWER CONVERSION EQUIPMENT |
| <input type="checkbox"/> SWITCH GEAR | <input type="checkbox"/> SUB-STATION EQUIPMENT |
| <input type="checkbox"/> SPECIAL ELECTRIC MOTORS | <input type="checkbox"/> PROTECTIVE EQUIPMENT |

Name..... Tel. No.....

Firm.....

Address.....

City..... State.....

319-1

WAR ASSETS ADMINISTRATION

OFFICES LISTED BELOW ARE TEMPORARILY IN
RECONSTRUCTION FINANCE CORPORATION AGENCIES

Offices located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cleveland • Dallas • Denver
Detroit • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles • Louisville
Minneapolis • Nashville • New Orleans • New York • Oklahoma City • Omaha • Philadelphia
Portland, Ore. • Richmond • St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane
Cincinnati • Fort Worth (Telephone 3-5381)

VETERANS OF WORLD WAR II: To help you purchase surplus property, a veterans' unit has been established in each WAA office.

Advertising In This Issue

*Adam Electric Co., Frank.....	41	Goodrich Chemical Co., B. F.....	126, 127	*Pyle-National Co., The.....	148
*Aerovox Corporation.....	168	Goodrich Electric Co.	173		
All-Bright Electric Products Co....	131	*Graybar Electric Co.	58	*Quadrangle Mfg. Co.....	130
*Allen Co., Inc., L. B.....	178, 184	*Greenlee Tool Co.....	150		
*Allis-Chalmers Mfg. Co.....	5	Guth Co., Edwin F.....	32	Reading Electric Co., Inc.....	156
*All-Steel-Equip Co.....	19			*Reliance Automatic Lighting, Inc..	156
Aluminum Co. of America.....	37	Harnischfeger Corp., P. & H.....	40	Republic Steel Corp.	22, 23
*American Coach & Body Co.....	45	*Hazard Ins. Wire Works Div...17,	77	*Revere Elec. Mfg. Co.....	184
*American Steel & Wire Co.....	30, 31	Howell Electric Motors Co.....	117	*Ridge Tool Co.....	48
*American Transformer Co.....	14	*Hullhorst Micro Tool Co. (Div. of		*RLM Standards Inst., Inc.	88
*Anaconda Wire & Cable Co.....	56	Toledo Standard Comm. Co.)...158		Robbins & Myers, Inc.	20
*Appleton Electric Co.....	2			Robertson Co., H. H.....	47
Armstrong Mfg. Co.....	184			*Roebbling's Sons Co., John A....	104, 105
Arrow-Hart & Hegeman Elec. Co....	152	*Ideal Industries, Inc.	162	*Russell & Stoll Co.	179
*Associated Projects Co.....	158	*Ilg Electric Ventilating Co.	35		
*Auth Electrical Specialty Co.....	146	*Illinois Electric Porcelain Co....	157	Sanciento, Samuel	186
Automatic Elec. & Mfg. Co.....	178	*Ilasco Copper Tube & Products Co.	174	*Sangamo Electric Co.	28
		*Insulation & Wires, Inc.....	108, 109	Sav-U-Time Sales Company	172
*Benjamin Elec. Mfg. Co.....	96	International Register Co.	175	Searchlight Section	186, 187
*Biddle Co., James G.....	147	International Tel. & Tel.....	29	Simplex Wire & Cable Co.	80
Blackhawk Mfg. Co.....	132			*Sorgel Electric Co.	171
Brady Company, W. H.....	164	*Jefferson Electric Co.	54	*Spang-Chalfant	78
*Briegel Mfg. Corp., L. S.....	185	Jenkins Bros.	181	*Spero Electric Corp.	46
*BullDog Electric Products Co....	94, 95	*Johns-Manville	155	*Square D Company.. Inside Back Cover	
*Burndy Eng. Co., Inc.....	49	*Johnson Bronze Co.	110	*Standard Transformer Co.	8
*Bussmann Mfg. Co.	42, 43			Steel & Tubes Div.....	22, 23
		Kahn Mfg. Co., Inc.....	137	*Sticht Co., Herman H.....	178
Camfield Mfg. Co.	18	*Kellems Company	84	*Superior Carbon Prod. Co., Inc....	112
Century Electric Co.	101	*Klein & Sons, Mathias.....	118	Syntron Company	166
Certified Ballast Mfrs.	133	Kondu, Corp.	170		
Certified Starters	4			Tal's Prestal Bender, Inc.	164
*Champion Lamp Works	138	*Leader Elec. Mfg. Corp.	15	*Thermador Elec'l Mfg. Co.....	25
Chelsea Products, Inc.	51	*Lint, Clyde W.	176	Thomas & Betts	27
*Chicago Transformer Corp.	116			*Toledo Standard Commutator Co....	158
Clark Co., Robert H.....	180	*McGill Mfg. Co.	134	*Tork Clock Co., Inc.	184
Clark Controller Co.....	10	McGraw-Hill Book Co.	182, 186	Trico Fuse Mfg. Co.	110
Crescent Ins. Wire & Cable Co....	113	*Mercoid Corp.	183	*Trumbull Electric Mfg. Co.....	144
Crouse-Hinds Co.	92	*Metropolitan Device Corp.	1		
*Curtis-Lighting, Inc.	82	*Metropolitan Elec. Mfg. Co.....	36	Union Insulating Co.	166
*Cutler-Hammer, Inc.	119	Miller Co.....	26	*United States Steel Corp.	30, 31
		*Mineralac Electric Co.....	180	United States Treasury Dept.....	50
*Day-Brite Lighting, Inc.	124, 183	*Mitchell Mfg. Co.	90		
*Dolph Co., John C.	114	Mónarch Fuse Co.	167	Virden Co., John C.....	123
		*Monitor Controller Co.....	39		
Economy Fuse & Mfg. Co.	151	Multi Electric Mfg. Co.	174	Wagner Electric Corp.....	107, 120
*Efficiency Elec. & Mfg. Co.	112	*M & W Electric Mfg. Co.....	176	War Assets Administration	187
Electric Equipment Co.....	186			*Ward Leonard Elec. Corp.	154
Employment	186	National Elec. Products Corp....	33	*Ware Brothers, Inc.	111
		North American Electric Lamp Co.	178	*Westinghouse Elec. Corp. (Lighting	
*Fairbanks, Morse & Co.	103	Nu Tone, Inc.	38	Div.)	135
*Faries Mfg. Co.....	165			*Westinghouse Elec. Corp. (Pitts-	
Federal Electric Products Co.....	122	*Okonite Co.	17, 77	burgh)	75
Federal Telephone & Radio Corp..	29	*Onan & Sons, D. W.	160	*Weston Elec'l Instrument Co....	121
*Feedrail Corp.	16			*Wheeler Reflector Co.	149, 154
*France Mfg. Co.	44	Paine Co., The	100	Where To Buy	184
*Frankel Connector Co.	181	Paragon Electric Co.	128	Wiremold Company	12
*Fullman Mfg. Co.	169	Pass & Seymour, Inc.	136	Wodack Elec. Tool Corp.....	184
		*Pelham Elec. Mfg. Corp.	161	*Wurdack Elec. Mfg. Co., Wm.....	86
Garden City Plating & Mfg. Co....	182	*Penn-Union Electric Corp.....	182		
*Gedney Electric Co.	184	Pittsburgh Reflector Corp.	129	Youngstown Sheet & Tube Co....	24
*General Electric Co. (Bridgeport)		Pryne & Co.	185		
Back Cover, 21, 142, 177				Zinsco Electrical Products.....	6
*General Electric Co. (Nela Park)..	139				
*General Electric Co. (Schenectady)					
Inside Front Cover, 7, 9, 11, 13,	34				
General Luminescent Corp.....	160				

★ These companies have supplied additional buying information on their products in the 1946 edition of the Electrical Buyers' Reference

Industry's Electrical Systems Have Taken a *Terrific Beating!*



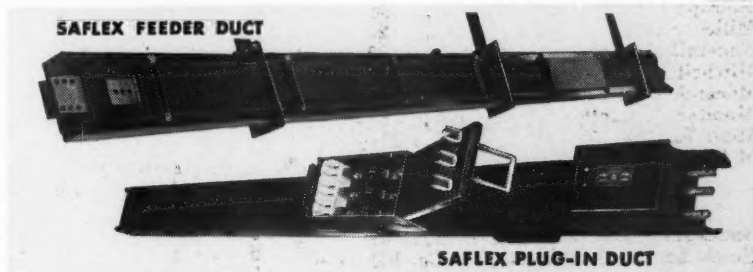
That's why so many industrial plants, large and small, need
SQUARE D Saflex Duct and Multi-Breaker Panels...*right now!*

• Today, thousands of industrial plants must modernize or replace overloaded or obsolete electrical systems, if large-scale production is to offset dwindling profit margins.

Square D Saflex Duct (Feeder and Plug-in) and Multi-Breaker Panelboards are "naturals" for this kind of modernization. To

the industrial plant, they deliver increased productivity with less power loss. To the electrical contractor, they open the door to plenty of industrial business.

For full information, ask your Square D Field Engineer, or write Square D Company, 6060 Rivard Street, Detroit 11, Michigan.

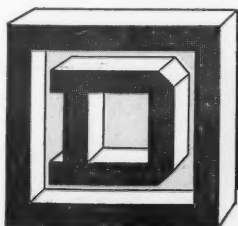
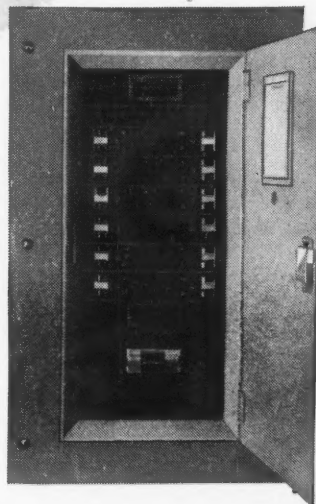


SAFLEX FEEDER DUCT runs cool, with temperature rise 50% lower than for other totally-enclosed busses of equal copper cross-section and rating. Balanced voltage drop of only 1.8 volts per 100 feet of 3-phase duct.

SAFLEX PLUG-IN DUCT permits plugging in machines whenever and wherever needed. Units easily attached and disconnected.

100% salvage for re-use. Available in 225, 400, 600, 800 and 1000-ampere capacities.

MULTI-BREAKER PANELBOARDS provide the economy and convenience of modern circuit-breaker protection. Eliminate fuses completely. Greater safety, dependability, flexibility, and lower installation cost.



SQUARE D COMPANY

DETROIT

•

MILWAUKEE

•

LOS ANGELES

Select the best raceway for the job

General Electric Offers Two Types of Rigid Conduit
to Safeguard Wiring... G-E WHITE... G-E BLACK

STOP Atmospheric Corrosion with G-E WHITE

Where heat, cold, sunlight, condensation, rain and sleet will attack your wiring, SELECT G-E WHITE CONDUIT. The hot-dipped zinc coating on G-E White Conduit enables this conduit to give permanent protection to your wiring against extremes of weather.

STOP Chemical Corrosion with G-E BLACK

General Electric provides a complete line of raceways—including rigid conduit, electrical metallic tubing, flexible conduit, Fiberduct, Q-Floor wiring accessories, and boxes and fittings.

For information, see your G-E Merchandise Distributor, or write to Sec. C661-8, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.

Where chemical liquids, acids, fumes and oil will attack your wiring, SELECT G-E BLACK CONDUIT. The baked enamel coating on G-E Black Conduit enables the conduit to give your wiring permanent protection against chemical corrosion.

GENERAL  ELECTRIC

